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POLARIZATION OF X-RAYS.

In a recent paper read before the Royal Society, of London, Dr. C. G. Barkla describes a method by which polarization of X-rays may be demonstrated experimentally. This is an important matter, since proof that X-rays can be polarized would be pretty conclusive proof that they are propagated by transverse, and not by longitudinal, vibrations of the ether, a conclusion which would settle finally the controversy which arose as soon as the discovery of the X-rays was announced by Dr. Rœntgen.

It is interesting to note that it was while searching for proof that the X-rays could be polarized that Blondlot discovered his so-called and now famous N-rays, a discovery which led him far away from the object of his original research. Blondlot did secure some results which indicate that polarization could be brought about, and it is to his credit to note that his preliminary results agree with the final results of Dr. Barkla.

THE TELEPHONE IN WAR.

Among many things which the Japanese have done during the war which they are now waging, and which have attracted the attention of the world, their use of the telephone is one. When the war first broke out, and while the question of supremacy on water was undecided, they made good use of wireless telegraphy. By this means the main fleet kept in touch with its scouts, and, indeed, in the final conclusive battle of last August, in which the Russian vessels left the harbor to attack a few apparently unsupported Japanese vessels, the latter called up the main Japanese fleet, then out of sight, but in waiting, by means of wireless telegraphy. On land the Japanese have erected telegraph lines as they advanced, and kept the government at Tokio in constant communication with all of the armies, and each army in touch with the other.

But to keep the commander of a single army in constant touch with his division commanders, the telephone has been used. As each advance was made, or a trench was dug, connections were made with headquarters by telephone. Thus, not only was all important information transmitted immediately to the commander, but fighting was directed from the latter point by the same means. The commander was able to direct the fire of the guns and to order advances when the proper time arrived. The telephone in this service has taken the place of the courier, and does the work better and more quickly. By its ability to communicate instantly with many and widely separated points, not only are the army's operations directed more effectively, but one commander is enabled to control a larger force than was possible under the old system. Take the last great battle as an example. Could Field Marshal Oyama have directed the operations of 400,000 men, and have timed his strokes so exactly, had he been forced to depend upon orders carried by horse? How could he have controlled a fighting line a hundred miles long? Without the telephone the operations would have been carried on by a number of generals, each acting according to a certain plan, but depending largely upon his own judgment for what to do and when to do it. That the fight would have been carried on as bravely, none can doubt, but the telephone coordinated the actions of each division, and reduced the armies to one vast machine. Nothing was left to chance; every stroke was correctly timed, and the commander-in-chief was at once informed of its result. Even the flying columns were followed by the engineering corps, and the result of every skirmish and the taking of every village were known, within a short time, at headquarters.

Besides making each of the divisions able to act with the others offensively, the telephone enabled them to act together

for defence. As soon as any point was threatened, this was known at headquarters, and moving orders could be issued to the most available reserves for support. Truly, the telephone has become one of the most important factors in modern warfare, and it is one factor—if not the only factor—which has acted to reduce the danger to the individual. The Japanese are brave enough, but, unless we except their action in battle, they make no sacrifice that is not necessary, and, being practical, they have used the telephone, not only for such purposes as require great speed, but at times when the risk to the messenger is the chief consideration. There is no longer any necessity for exposing couriers to the fire of the enemy.

PRECAUTIONS IN THE USE OF ACETYLENE.

Some of the more obvious dangers in the use of acetylene are well recognized, and are fairly well provided for in the newer types of acetylene generators. These are the precautions which any one with common sense would take in handling and using an explosive gas. There are, however, other dangers involved which are not so well recognized. In a recent paper presented by Mr. W. D. Grier before the National Fire Protection Association, the hazards involved in the use of acetylene are discussed, and the precautions which should be taken when this illuminant is used are pointed out.

With the hazard of manufacture but few are concerned. These are, of course, the use of high-tension electric current, and in the handling and storing of the material which, when exposed to moisture, gives off an inflammable gas and evolves much heat. A factory for manufacturing such material should be of entirely non-inflammable material. It should be well ventilated, and the electrical work should be of the most approved kind.

One of the dangers which the user of acetylene should be aware of is the explosive nature of the mixture of acetylene and air. There is a greater danger here than with the use of illuminating gas, because a mixture of air and acetylene will explode, if ignited, when it consists of any proportions of acetylene between 3.3 per cent and eighty-two per cent. The corresponding figures for hydrogen are five per cent and eighty per cent, while for carbon monoxide they are thirteen and seventy-five per cent. Thus, when acetylene is allowed to escape into a room, a dangerous mixture results sooner than with other common inflammable gases. In the same way, when air is allowed to enter a vessel containing acetylene gas, the explosive mixture is reached earlier than with other gases. The pungent odor of acetylene acts is a safeguard against the former danger, for an escape of acetylene into a room should be noticed some time before the danger point is reached. As far as the poisonous character of the gas is concerned, it is said to be less dangerous than city gas, because its presence is more readily noticed, and it does not contain an active poison like carbon monoxide.

Another risk involved in the use of acetylene should be known by every one. This gas, in the presence of moisture and ammonia, acts upon metals, notably copper and silver, to form a class of bodies known as acetylides, which are more or less explosive. Ammonia is one of those materials which are to be found in every household. Nothing would be more natural than for one to make use of this substance for cleaning gas fixtures or a bicycle lamp, but it should never be used for this purpose when the illuminant is acetylene. In this same class of danger comes the use of chloride of lime for purifying the gas. Still another precaution is that the generator should be so constructed as to avoid all possibility of putting the gas under a high pressure, for it then becomes dangerous. When the pressure has reached a point where the gas is liquefied, it becomes a true explosive, and capable of detonation or ignition with terrible results.

Acetylene is one of the welcome additions to our illuminants. It gives a beautiful light when properly shaded, and when correctly handled is comparatively safe. For certain fields, such as the lighting of country places, where an electric light plant would be out of the question, it is unsurpassed; but those who use it should be aware of the dangers involved, and should observe every possible precaution against accident.

STARTING RESISTANCE FOR INDUCTION MOTORS.

A point which is frequently made to the disadvantage of the continuous-current motor, and in favor of the alternating-current induction motor, is that the former requires a starting resistance which wastes a certain amount of energy every time the motor is started; while the induction motor may be started by an autostarter with a smaller loss of energy. Viewed from the standpoint of the motor user, this is true, but from the viewpoint of the central station the method of starting an induction motor by means of an autotransformer or other similar device may be more objectionable than the use of simple resistances. As a general thing, the supply station can handle better a sudden load which has a high power-factor than a smaller load having a smaller power-factor. The first load may affect the voltage but little, and, through the more common methods of compensation, may itself correct the voltage for the additional load. Throwing an inductive load on, as is done when a motor is started by means of an autotransformer, is likely to affect the voltage of the supply more seriously, and to be harder to handle, even though the current drawn in each case may be the same. For very large motors this starting resistance is more suitably placed in the secondary circuit of the motor, but for smaller motors a simple resistance connected in series with the motor will frequently reduce the effect on the station, of starting the motor to a point where it may cause no inconvenience. When the motor is started but a few times during the day, the loss of energy in the rheostats is practically negligible; on the other hand, where many starts must be made, the frequent throwing on and off of an inductive load is anything but desirable at the station.

RESPONSIBILITY IN STRIKES.

It is probable that a valuable lesson will result from the recent strike on the New York subway and the elevated lines. Without entering upon the justice or injustice of the demands made by the strikers, it seems apparent that they did not realize their responsibilities. Of course, every man has a right to quit work if he pleases. The question, however, may be raised, whether a body of men has a right to stop work when it knows that doing so will seriously inconvenience a large number of persons who are in no way concerned in the quarrel. The strikers themselves would surely object seriously if the company, on very short warning, should dismiss them all because they refused to do more work for the same pay as they had been receiving; yet, while they had been contented with what they were getting, they made certain demands, refused to arbitrate, and all quit, hoping that the company would not be able to keep in operation a service so necessary to the city.

In operating a public service, the company acknowledges that it has certain responsibilities, and it is subject to public control, to a considerable extent. Part of this responsibility should be borne by the employés of the company. The city has been to an enormous expense to secure certain traffic facilities absolutely required. It has made a contract with the Interborough Rapid Transit Company to operate this system for a certain number of years; yet if the employés could have their way, the public would have been deprived—for no one knows how long—of all that the city has been to so much expense and so great inconvenience to secure. As it was, much loss, as well as inconvenience, was caused for several days.

Although the greater blame must be laid upon the strikers for the recent trouble, a strike brings, as well, certain responsibilities to the operating company. The latter, in deciding upon the justice or injustice of the demands of its employés, must always bear in mind the rights of the public. When a strike takes place, while it makes every effort to give its regular service, it must first of all consider the safety of its passengers. Inexperienced men must not be put in charge of cars. It would be better to reduce the service to one-half, or even one-third, and increase it as fast as the available men could be obtained, than to risk putting men not thoroughly competent in charge. It is not very difficult to operate a train equipped as the subway trains are. A cool-headed man can learn to do this in a few weeks, and, as our trains are operated to-day, there are generally a large number of men available who can handle a fully equipped electric train. We believe that the Interborough Rapid Transit Company appreciated this responsibility and lived up to it as far as it was able. The fact that but one serious accident occurred, although practically all the crews were strange to the system, however experienced they may have been in the handling of cars, shows that great care was taken in the selection of new men.

It is sincerely to be hoped that the lessons of the recent strike will be learned, and that other methods will be found for adjusting difficulties. The city of New York owns the subway, and, before many years, it probably will own an elaborate system of subways. When this day comes, there must be no possibility of having all trains stopped because a comparatively small number of men are dissatisfied.

OIL-INSULATED TRANSFORMERS.

On another page of this issue appears an interesting discussion of the merits of the oil-insulated transformer. The author, Mr. M. A. Sammett, gives the results of his personal experience with this type of transformer, his conclusion being that it is a better fire risk than the air-insulated type. One extreme case is described, in which the transformer, though very much overloaded, operated satisfactorily, even after the insulating windings on the wires had been completely charred. No other type could have operated under such adverse conditions. Here, however, although the charred material formed a conductor, this was so thoroughly permeated with the oil that there was no complete electrical path between adjacent turns of wire. The insulation then consisted only of the exceedingly thin films of oil which separated the charred surfaces, and the charred surfaces and the wire.

As a precaution, Mr. Sammett advises that means be provided for draining off the oil from the transformer case, should a fire occur, and he favors for this the method proposed by Mr. Ralph D. Mershon at a meeting of the American Institute of Electrical Engineers, held during March, 1904. In this plan the transformer is enclosed in a fireproof vault, and pipes are provided whereby water can be forced into the bottom of the case, driving out the oil through a pipe at the top. The advantage of this method is that, should the oil be burning, the water will surely put out the fire, but it involves the disadvantage of introducing water into the transformer case. It is true that, as all parts of the transformer are thoroughly saturated with oil, this may not cause any trouble, but it is certainly undesirable to fill the transformer case with water.

The oil might be drawn off by simply opening the pipe at the bottom, allowing it to flow out, but such a proceeding might be dangerous. As air is drawn in to fill the space being emptied of oil, an explosive mixture may be formed, with disastrous results. It would seem better to force the oil out at the bottom by means of some inert and harmless gas. Nitrogen, carbon dioxide or ammonia might be used. Forcing ammonia into the case would smother any fire existing there, and would enable the oil to be forced out rapidly at the bottom. The ammonia gas would itself have no deleterious effect on the transformer.

While drawing off oil from the transformer case removes from the building a material which may become inflammable, it leaves the transformer itself more exposed to injury from external heat. This objection could be got over by having the transformer room constructed so that it could be closed up air-tight. In case of a fire, this room could be filled completely with ammonia, which would prevent a fire from starting there. If the transformer vault is suitably constructed, it is hardly probable that a fire outside of the room would heat the oil sufficiently to drive off inflammable gases.

THE COMMERCIAL ASPECT OF ENGINEERING.[1]

BY CHARLES A. S. HOWLETT.

The engineer who makes a business of securing the contracts is known as a contracting or sales engineer. The presidents of our large manufacturing and engineering organizations are very good examples of successful contracting and sales engineers. They possess traits that are inborn, and others that are developed, which enable them to successfully influence others. And this definition applies equally as well to a successful lawyer or preacher and many other professional men. This distinction should be kept in mind, however. After a contracting or sales engineer has attended to the commercial side of his work he must immediately proceed to carry out the work without fault or blemish, whether it be the furnishing of engineering knowledge or machinery, or both. His ultimate success depends greatly upon a diligent attention to details, harnessed to an extended experience, which should produce successful work.

Success in the commercial phase of the work, without proper support from a purely engineering standpoint, would be more embarrassing than a thorough knowledge of the engineering features, without any commercial capacity. The success of the contracting or sales engineer depends on his salesmanship first, and his engineering ability second.

This would be disputed by some who claim that both should be equally developed. Theoretically this is correct, but practically it is not, due to the fact that from the nature of their training there are comparatively few engineers with a knowledge of salesmanship. Therefore, when several are endeavoring to secure a contract for machinery, or services as engineer, the questions discussed do not require as thorough a knowledge and familiarity with the purely engineering problems involved as the ability to secure the contract. The one most proficient in the selling art will naturally be the most successful.

The question then that comes home to us is, how can we best equip ourselves to secure a good portion of the available business; and if we are doing that now, as some of my worthy competitors will claim, how can we best increase it?

The average contracting engineer has, as a rule, two commodities to dispose of —his services or technical ability and manufactures, and sometimes both.

Eliminating the consideration of the purely engineering phase of the subject, by assuming for the moment that we all have the same capacity and experience and are equally well informed, how can we become more proficient in the commercial side of our calling?

The remedy may be divided into two parts:

1. That applicable to those now in the business, and

2. That applicable to the young engineers who are now in the technical schools.

"That applicable to those now in the business." Briefly it consists of the devotion of considerable time, in study and training, in mastering the rudiments of such subjects that have any bearing on the making of a commercially successful engineer. The principal subjects have already been mentioned. They are psychology, logic, expression and elocution.

There are a number who have given a great deal of thought to these and many more, with particular reference to their commercial bearing.

Schools of salesmanship conducted by correspondence have been organized and developed, which contain the vitals of a great many subjects of assistance in securing business. One may profitably be guided by their forms and methods.

Division 2 of the remedy has to do with the young engineers now in the technical schools.

The average college-bred engineer receives a very thorough training in all manner of studies—arranged in carefully planned courses—by learned professors. The object being to train the mind, to enable the graduate to tackle and successfully solve engineering problems. But unfortunately, the average engineer receives absolutely no training in the development of the mind or in any other way to enable him to secure the opportunity to solve the problems. If shortly after graduation, with finishing touches in some large factory, the embryo engineer starts into business, he is confronted with the very perplexing problem of how to secure the contracts for his services. He will find a number of experienced men after the same contract, and he will realize that before he can presume to have the standing of his senior competitors, he must have carried to successful completion a number of contracts. But how is he to secure them?

Many young engineers in this predicament find that it is necessary to spend considerable time, to obtain by actual experience a knowledge of the commercial phase of their profession.

Would not our engineering school training then be much more complete and a great deal more beneficial if it embraced studies that would give us the benefit of the successful commercial side of the profession, as well as the purely engineering? Why can not we be taught to take advantage of the experience of the successful salesman?

I believe we can, and would suggest the following remedy:

All professional schools, such as technical, medical, law, dental, agricultural, mining, pharmacy and the like, should incorporate in their senior year such studies as would develop the mind in a manner that would inspire in the student commercial instincts—that would help him to profit by the experience of others in securing an opportunity to perform the work that his professional training enabled him to handle.

If such studies be introduced, I believe it would materially increase the efficiency of such schools and materially improve the standing of professional men by making them the powers—in this commercial world. It is particularly noticeable that of the successful men, those with the professional training are the most powerful.

Some will say that the art of securing the contracts is a gift, and maybe it is. If so, Dame Nature was not very generous when she distributed her gifts among the professional men. I would say that salesmanship is not a gift necessarily, but the development of certain traits more or less common to all of us. Those with natural instincts will be more highly developed with the same training than those less gifted. In the same way that those with natural instincts will be more proficient musicians, with the same training than those less gifted.

[1] Abstract of a paper read before the electrical section of the Western Society of Engineers, January 18, 1905.

The Philadelphia Bell Telephone Company.

The stockholders of the Philadelphia (Pa.) Bell Telephone Company held their annual meeting on February 21. Mr. Charles F. Cutler, chairman, and the board of directors were reelected. The earnings for the year aggregated $3,756,059.79, of which $3,538,654.39 was derived from exchange and toll service. The company had 82,497 stations in service on January 1 last, an increase of 15,229 over the same time last year. It is the management's intention to increase this number by 27,000 during the present year.

Oil-Insulated Versus Air-Blast Transformers.

Practical Results Showing the Superiority of the Oil-Insulated Type.

By M. A. Sammett.

AT a recent meeting of the American Institute of Electrical Engineers, the question of relative fire risk of oil-insulated and air-blast transformers received a very thorough discussion. The profession was represented by the best men, whose opinion on this question was based on wide experience, and strange to say there was a decided division as to the relative fire risk resulting from the use of the two types of transformers. Many were very decidedly opposed to the use of oil transformers, considering them a menace to the plant of which they are only a part, and advocated the use of air-blast transformers as more safe a piece of apparatus. Others, on the contrary, strongly advocated the use of oil-insulated transformers and recommended as a further protection specific safety arrangements to be used in connection with them.

The experience of the writer has been such that he considers the oil-insulated transformer much more preferable to the air-blast type. The oil transformer is more adapted for high voltage work, will take good care of a short-circuit, extinguishing the arc, and, generally speaking, will minimize the fire risk likely to be caused by internal, inherent defects of the transformer coils. Again, the oil-insulated type will stand considerable overloads, and, as will be seen from the description given below, will safely operate under certain conditions at a temperature of 200 degrees centigrade.

This interesting case, which is described in detail below, shows the high endurance of the oil type of apparatus, and, though almost incredible, the working conditions were reproduced in the testing department of the operating company in order to check results, which were duplicated in this check test.

When the extremely high temperature was reported by the inspector, it was removed from the customer's premises, and it is interesting to note that after the transformer was cut off the circuit for sixteen hours, it registered a temperature of ninety-eight degrees centigrade in the oil. The temperature of surrounding air was twenty degrees centigrade.

In view of the extraordinary conditions of temperature under which the transformer operated, it was desirable to make a thorough test of the transformer, measure the losses, examine into the cause as to the abnormal temperature, test the oil for the flashing and burning point, as well as examine and analyze the design of the transformer.

This transformer was in operation for about five years with another transformer of same make and capacity, and while it was running quite hot, requiring on several occasions an addition of a new supply of oil, the second transformer did not have the annoying characteristics of its mate. The transformers in question were twenty-four-kilowatt, sixty-cycle, 2,000-550-volt.

TRANSFORMER REMOVED FROM TANK AFTER TEST.

They were connected at first to a two-phase circuit and were converting two-phase current to three-phase. As the secondary winding was provided only with fifty per cent taps, to secure phase transformation, the fifty per cent tap of one transformer was connected to 100 per cent lead of the second transformer, instead as it should be to 86.6 per cent, and it was the transformer originally connected with the fifty per cent tap that ran hot. About ten months prior to observing the dangerously high temperature the transformers were connected to a three-phase, 2,200-volt, distributing circuit and were converting three-phase, 2,200-volt, to three-phase, 605-volt, on an open delta connection, and it was during these ten months after the change that the abnormal rise took place.

CONNECTED LOAD.

The load on the transformers, as determined from the input of the two motors connected to them, showed the following:

Motor.	Amperes.	True Horse-Power.	Apparent Horse-Power.
1	31.0	32.2	39.1
2	6.5	7.1	10.0
..	37.5	39.3	49.1

From these data it is evident that the transformers were not overloaded, the actual load, figuring on the basis of amperes per phase, amounting only to $\frac{37.5}{45.8} = 81.7$ per cent of full load. As observed before, the mate of this transformer, of identically the same construction, ran fairly cool, the temperature of oil amounting to seventy-two degrees centigrade.

The first thought that suggested itself in explaining the cause of such high temperature was ageing of the core iron and when the core loss was measured the following was found to be the case:

605 volts; 1.64 amperes; 770 watts.

The core loss was taken at 605 instead of 550 volts, as this is the voltage corresponding to the actual primary voltage of 2,200 volts, at which it operated. The increase in the iron loss, resulting from a higher voltage, amounting to ten per cent will be increased by only $\left(\frac{2,200}{2,000}\right)$ raised to 1.6 power, which when expressed as a constant will be 1.16 times the original core loss at 2,000 volts.

From data derived in tearing down the transformer, the magnetic density in the iron figures out to be 41,800 lines of force per square inch, calling primary voltage 2,200, and from a curve giving the relation between induction in iron and watts loss per pound of iron, it is inferred that the core loss originally did not exceed 335 watts. Considering then that the transformer had to dissipate 435 watts in addition to the losses it was designed for, the cause of the abnormal temperature will become quite apparent. Adding to the 770 watts of loss in the iron 408 watts of copper loss of the primary and secondary coils, the total loss will come to 1,178 watts and no adequate means to dissipate the

heat. Besides the additional loss in the iron a heavy deposit of asphaltum-like residue all around the core prevented proper circulation of the oil. As will be seen from the photograph of the transformer, the lower portion exposes the iron, the residue of oil being removed, while the upper portion is heavily coated with a thick oily mass. It is this heavy coating and the excessive losses that are responsible for the high temperature.

Comparing the iron loss of the transformer described here and modern transformers of good design, intended to operate at the same frequency, the comparison will stand as follows:

Core loss of twenty-four kilowatts, sixty cycles, between 195 to 235 watts.

Core loss of twenty-four kilowatts, sixty cycles (described), 770 watts.

DATA DERIVED FROM TEST.

	Ohms.
Primary resistance at twenty-five degrees centigrade	1.8
Secondary resistance at twenty-five degrees centigrade	0.0123

Core loss, 605 volts, 1.64 amperes, 770 watts, sixty cycles.

Impedance (full load current).

10.9 amperes, 880 volts, 405 watts.

Calculated copper losses.

	Watts.
Primary	214
Secondary	194
Total core loss	408
Iron loss	770
Iron and copper loss	1178

Efficiency full load, 95.32 per cent.

DESIGN DATA.

Rating twenty-four kilowatts, 2,000 to 550 volts, 60 cycles.
Iron core width, 2 inches.
Iron core height, 22 inches.
Wire space, 5¾ inches by 6¾ inches.
Induction in iron in megalines, 1.672.
Density per square inch, 38,000 (2,000 volts primary).
Cross-section of core, 44 inches.

Primary.

Total turns, 450.
Number of coils, 6.
Dimension of conductor, No. 9 square wire.
Density, 925 amperes per square inch.
Turns per layer, 6.
Number of layers per coil, 12⅛.

Secondary.

Total turns, 124.
Number of coils, 4.
Dimension of conductor, 0.750 inch by 0.062 inch.

Density, 935 amperes per square inch.
Weight of iron core, 399 pounds.
Weight of primary and secondary copper, 256 pounds.
Dimensions of tank, 4 feet 6 inches high by 23 inches diameter.

After the preliminary test, the transformer was connected for a heat run, first on open circuit, to get the data of heating on core loss alone, and then under conditions of full load.

As will be seen from curve of full load heat run, the temperature of the primary coils reached a maximum of 200 degrees centigrade, giving a rise of 180 degrees centigrade, with a room temperature of twenty degrees centigrade. On the customer's premises this transformer at eighty-one per cent full load had a temperature of 200 degrees centigrade, with a room temperature of forty degrees centigrade.

Having traced the cause of the abnormal heating of the transformer to ageing of the iron, it would be interesting to explain this unique phenomena. The peculiarity of iron changing its magnetic property when used in alternating-current ap-

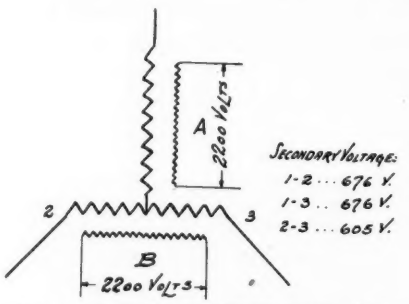


FIG. 1.—TWO-PHASE, THREE-PHASE. UNBALANCED SECONDARY VOLTAGE.

paratus was observed for the first time by G. W. Partridge, in 1894. After having made public some experimental data relative the increase of iron loss in transformers, the question received close investigation in view of its importance. Soon it was ascertained that the phenomenon is due not to any magnetic or electric causes, but was purely the effect of relatively high temperature at which the iron was maintained, on the magnetic properties of iron. The same effect was observed when transformers were placed

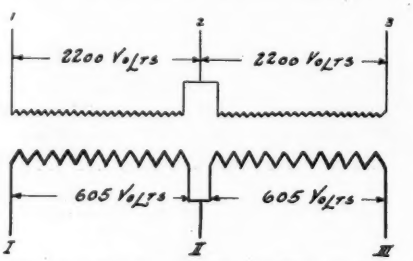


FIG. 2.—CONNECTION UNDER WHICH THE TRANSFORMER RAN HOT.

in baking ovens, where they were kept at a predetermined temperature, and after a given time the hysteresis loss increased considerably as compared with the original loss, same as it is observed with the transformer under operating conditions. It was also observed that ageing increases with the increase of temperature.

Manufacturers of electrical apparatus while working in the direction of securing a non-ageing iron had to work out designs of machines with a possible commercial minimum temperature rise. At the time the transformer discussed in this paper was built, the non-ageing iron was non-existent and the unstable quality of the iron is responsible for the increase in the iron loss and consequently for the abnormal temperature. With transformers of modern construction, when manufacturers have developed certain processes by which they are able to produce the non-ageing iron (relatively speaking) this unstable condition is done away with and the oil transformers are in no danger of attaining hazardous temperatures through this source. Cure of rise in hysteresis will show the effect of increased temperature on core loss and the tendency of larger increases at higher temperatures will be easily observed. This tendency, however, does not follow any fixed law, but is somewhat erratic and upon reaching a certain point the loss diminishes with the increase in temperature.

After all the data to be had from test were secured, the question as to the voltage necessary to break down the winding, after

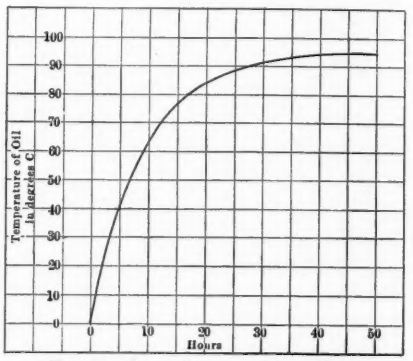


FIG. 3.—OPEN CIRCUIT HEAT RUN.

operating at such an extreme temperature, was of considerable interest. This could not be very successfully carried out on account of not having on hand an alternator of high frequency. Testing the transformer at sixty cycles only double voltage could be impressed, the iron being fully saturated at about 76,000 lines per square inch, and a further increase in voltage was impossible. The primary and secondary coils successfully withstood a ground test of 10,000 volts, thus adding further proof as to the good properties of oil-insulated transformers.

When the transformer was removed from the tank it was found to be coated with a heavy asphaltum-like residue of about one and one-half inches thick. The insulation separating the coils and insulating them from the core was so brittle that the slightest pressure of the hand made it fall to pieces or turn into a soft carbonized mass. The insulation between turns and layers was completely charred

and it was the film of oil, though impregnated with carbonized matter, that provided the effective insulation.

Were this a dry transformer it would have burned out long before it would reach a temperature of 200 degrees centigrade. The same would hold true in the case of an air-blast transformer, where the force of the draught would blow away the charred insulation and so hasten the time of the breakdown.

It is the oil, generally understood to be an easily inflammable substance, that makes this type of apparatus so objectionable to some engineers. In reality it is no easy matter to set oil on fire and, as shown by samples of the mineral seal oil used in this transformer, the flashing point of the oil gases was at 175 degrees centigrade and the oil was heated to a temperature of 235 degrees centigrade, the maximum range of the thermometer, and it did not catch fire. Under ordinary conditions a

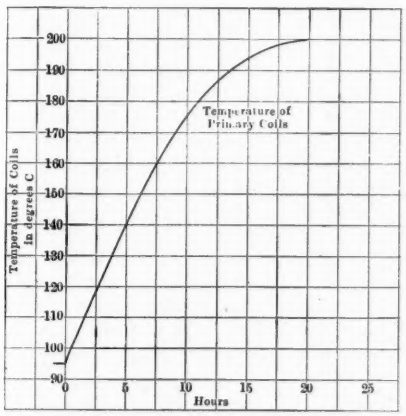


FIG. 4.—FULL LOAD HEAT RUN.

burning match or burning waste when thrown into a tank of oil will be extinguished.

The only danger of the transformer catching fire was likely to be on account of a flame getting in the neighborhood of the volatile gases, issuing from the transformer oil, but no immediate danger could be anticipated on account of the oil burning, as there was still a considerable margin, allowing a further increase of temperature. The transformer while in service was installed in a separate fireproof compartment. The cover was not completely sealing the tank and there was considerable space between the leads and porcelain bushings. The tank of this transformer was made of boiler-plate, one-quarter inch thick, riveted together, and did not show the slightest sign of oil leaking in any part of the case. It may be well to analyze further the design of the transformer in order to bring out the point of high-insulating qualities of oil. The fact that the only insulation in this transformer was the oil, since all the insulating material was carbonized, shows what a thin film of oil would do. The primary coils were wound in layers of six turns per layer, thus making the maximum difference of potential between layers of sixty volts, allowing for the double-cotton cover insulation of the wire twelve mils, and ten mils for the varnished cambric between layers, total space separating the wire between layers amounts to twenty-two mils, and the film of oil, though impregnated with the conducting carbonized insulation, withstood the voltage without difficulty. A dielectric test of a sample of oil taken from this transformer has proved it to possess a high-resisting quality, as it took 27,000 volts to break through a space of one-eighth inch, the voltage being applied to needle points.

From the various records of stations destroyed by fire the causes of fire were not the oil transformers. It originated most frequently either in a short-circuit at the switchboard or was due to the arc of a destroyed fuse on a high-potential panel.

So in the instance of the destruction of the Blue Lakes power plant in California, though the real cause was never ascertained, it is an established fact that it originated at the wooden high-tension switchboard and the burning insulation of the cables carried the flames to the wooden structure of the transformer platform, saturated with oil, through leaking transformers. Careful investigation proved conclusively that it was not a transformer trouble, as every foot of the winding was gone over carefully and it was established beyond any doubt that if the transformers were kept in separate fireproof compartments they would have been saved from destruction.

Again, in the instance of the disastrous fire in the power-house of the Helena Light and Traction Company, at Helena, Mont., it is interesting to note that almost the entire building and machinery were demolished and only some oil-insulated transformers were saved, due to the fact that they were immersed in oil, and so the vital parts of the transformers were left uninjured. If not for the open covers of the transformers which carried an overload, and were opened to facilitate the cooling, the transformers would have remained intact. Under the circumstances a part of the oil burned away, but no harm was done to the coils proper. There were also some oil-insulated potential regulators which were practically uninjured, with the exception of some damage done to the terminals. The result of the Helena fire has proved again that the oil-insulated apparatus is far more immune from fire than any other apparatus.

For the sake of comparison the writer would mention a case when air-blast transformers burned out, causing very near the destruction of the entire substation. Of the four banks of air-blast transformers burned out, causing very transformers per bank, delta connected, one bank was supplied on a new contract by the manufacturer to operate in multiple with the other three banks, dividing the load proportionately. The new bank had to be installed under the pressure of the heavy load in December

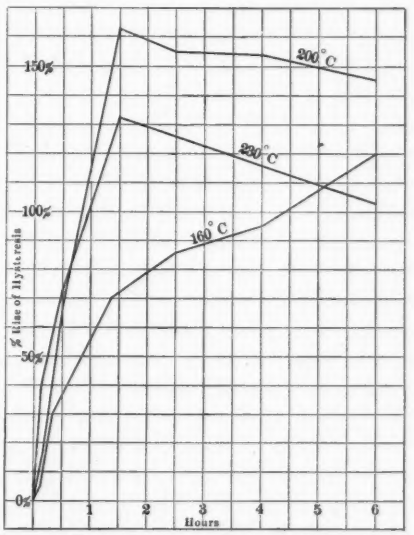


FIG. 5.—PERCENTAGE IN RISE OF HYSTERESIS.

and there was no time to have them tested to get the characteristics of the transformers. There were no separate meters on this bank and as the apparatus happened to be—as was proven subsequently by testing two other transformers supplied on same contract—of better regulation with a much smaller impedance they carried a considerable overload and finally broke down. Fortunately, they were installed over a separate air chamber, as otherwise the fire could have spread along the leads to the other transformers and destroyed the entire station. With proper precaution in installing the oil-insulated transformer possesses advantages which makes it a much safer apparatus, and the tendency in all new power transmission installations is toward the oil-insulated, water-cooled transformers, the use of which is considered good engineering. On several occasions the writer had an opportunity to be in a station where some old type

12,000-volt transformers broke down. On account of the usage they had the transformers were not in the best of condition and whenever a short-circuit happened in the transformer proper the oil took care of it every time, even when the short was held on for a minute or so.

Oil-insulated transformers should, to follow good practice, be placed in separate fireproof compartments, though this complicates the wiring of a high-voltage station. Means should always be provided to draw away the oil should the transformer catch fire. This latter can be accomplished as is being done in some instances by introducing water under pressure to the transformer case which displaces the oil. This refinement, which may very seldom be made use of, ensures further safety and makes the oil-insulated transformer the apparatus of the modernized and new station of to-day.

Scope and Effect of Competition on Telephone Development.

Mr. Vinton A. Sears, treasurer of the Automatic Telephone Equipment Company, Boston, Mass., has brought out a book entitled "Telephone Development, the Scope and Effect of Competition." In this work Mr. Sears compares the independent telephone systems with the Bell system, gives the status of the telephone industry, presents letters from editors of leading technical and trade journals, and, in fact, takes up the whole subject of telephony from the independent standpoint. The status of the telephone industry is shown in a number of tables. The Bell systems have a total value in capital stock, bonds and notes of $602,000,000. There are forty-four systems, 1,600 main exchanges, 2,000 branch offices, 4,000 switchboards and 1,800,000 subscribers. The independent systems represent an invested capital of $250,000,000, 5,000 systems, 7,500 public exchanges, 8,000 switchboards and 2,000,000 subscribers.

On a New System of Wireless Telegraphy.

The Royal Academy of Lincey, Turin, Italy, has published some abstracts of a letter to the chairman of the academy by Signor Alessandro Artom, on a new system of wireless telegraphy. This letter outlines the experiments which were made with Signor Artom's wireless telegraph apparatus in conjunction with the Royal Italian Navy.

POLARIZED ROENTGEN RADIATION.[1]

BY DR. CHARLES G. BARKLA.

Experiments on secondary radiation from gases and light solids subject to X-rays showed that the character of this radiation differs only very slightly from that of the radiation producing it, and that the energy of this radiation is proportional merely to the quantity of matter through which a beam of Rœntgen radiation of definite intensity passes, being independent of the kind of matter. These results, and the agreement between the energy experimentally determined and that calculated, led to the conclusion that this radiation is due to what may be called a scattering of primary X-rays by the corpuscles or electrons constituting the molecules of the substance.

On the hypothesis that Rœntgen rays consist of a succession of electromagnetic pulses in the ether, each electron in the medium through which these pulses pass has its motion accelerated by the intense electric fields in these pulses, and consequently is the origin of a secondary radiation, which is most intense in the direction perpendicular to that of acceleration of the electron, and vanishes in the direction of that acceleration. The direction of electric intensity at a point in a secondary pulse is perpendicular to the line joining this point and the origin of the pulse, and is in the plane passing through the direction of acceleration of the electron. On this theory, a secondary beam whose direction of propagation is perpendicular to that of the primary, will be plane polarized, the direction of electric intensity being parallel to the pulse front in the primary beam. If the primary beam be plane polarized, the secondary radiation from the charged corpuscles or electrons has a maximum intensity in a direction perpendicular to that of electric displacement in the primary beam, and zero intensity in the direction of electric displacement. The secondary radiation from light substances was too feeble to allow accurate measurement of the intensity of the tertiary radiation.

A consideration of the method of production of primary Rœntgen rays in an X-ray tube, however, leads one to expect partial polarization of the primary beam proceeding from the anticathode in a direction perpendicular to that of propagation of the impinging cathode rays, for there is probably at the anticathode a greater acceleration along the line of propagation of the cathode rays than in a direction at right angles; consequently, in a beam of X-rays proceeding in a direction perpendicular to that of the cathode stream there should be greater electric intensity parallel to the stream than in a direction at right angles. Such a beam was therefore used as the primary radiation, and the intensity of secondary radiation proceeding in a direction perpendicular to that of propagation of the primary beam from a radiator placed in that beam, was studied by means of electroscopes.

In the final form of apparatus the intensity of secondary radiation was measured in two directions perpendicular to that of propagation of the primary radiation and to each other, while the intensity of the primary beam was measured by a third electroscope. Using paper, aluminum, or air, as the radiator, as the bulb was turned round the axis of the primary beam studied, the intensity of a secondary beam was found to reach a maximum when the direction of the cathode stream was perpendicular to that of propagation of the secondary beam, and a minimum when these two were parallel, one electroscope recording a maximum rate of deflection when the other recorded a minimum. Many experiments were made which proved the evidence of partial polarization conclusive. When heavier metals, such as copper, tin and lead, which emit a secondary radiation differing considerably in character from the primary producing it, were used as radiators, no variation in intensity of secondary radiation was observed as the bulb was rotated. This result was not found to be affected by a considerable variation in the penetrating power of the primary radiation. Experiments were made with several X-ray tubes.

[1] Abstract of a paper read before the Royal Society of London on February 16, 1905.

German Electrical Developments.

An interesting phase of the electrical developments in Germany is the increasing use of power. To illustrate this, the following are the figures showing the growth of one Berlin company: until 1889 all of the output of the station was used in lighting, and at this time the aggregate was a little over 2,000 kilowatts. In 1889 it was increased to 2,457, and there was sixty-five horse-power in motors. The motor load has increased rapidly, practically doubling every year for the first four years. In 1895 the lighting load was 10,752 kilowatts, and the motor load was 2,252 kilowatts. In 1900 the motor load overtook the lighting load, the former being 22,037 kilowatts, and the latter 21,122 kilowatts. For 1904 the loads on the station were: for lighting 36,195 kilowatts; for motors, 44,448 kilowatts. These figures do not include power used in railway motors. During this year the number of motors which were in operation was 12,933, and the number of consumers for both light and power was 12,265.

Safety Devices for Preventing Excessive Pressure Rise in Alternating-Current Systems.

Two patents have been taken out recently in England for methods designed to prevent excessive pressure rise upon opening or closing electric circuits. One of these patents has been granted to the Lahmeyer Electrical Company, of London, and is entitled "improvements in safety devices for protecting dynamo-electric machinery and the like against the excessive voltage occurring when they are switched in or out."

Experience has shown that when machines are switched in or out disruptive discharges may easily occur, and that this principally happens in the coils or parts of conductors which are nearest to the current-supplying mains. This is clearly seen by the following test made by the inventors. A three-phase motor wound for a phase voltage of 10,000 volts and having eight coils per phase was connected to a source of electromotive force of 10,000 volts. The voltages in the several coils then ascertained are recorded in the following table. It will be seen that while under normal conditions there

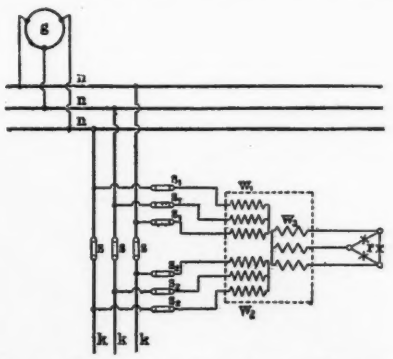
Voltage on Switching in the Motor as Measured Along	Without Any Choking Coil. Volts.	With a 720-Volt Choking Coil Switched In. Volts.	With a 1,100-Volt Choking Coil Switched In. Volts.	With a 1,800-Volt Choking Coil Switched In. Volts.
First coil.....	8,000	4,000	3,060	2,000
Second coil.....	4,000	2,500	2,000	1,500
Third coil	2,500	1,600	1,500	1,150
Fourth coil.....	1,800	1,300	1,100	900
Fifth coil.....	1,300	1,000	900	820

is in each coil a pressure of 10,000/(1.73 $\times$8) or a little over 720 volts, there is set up in the first coil when the motor is switched in a voltage eleven times as high. To remove this dangerous pressure from the machine, the first coil, which showed the largest increase of voltage, was connected in series with a choking coil which chokes under normal working conditions the same amount of voltage as every armature coil.

It will be seen from the third column that the excess of voltage at the first coil is reduced from 8,000 to 4,000 volts, or one-half. Further measurement also showed that an increase of 8,000 volts took place at the choking coil. If an 1,100, or an 1,800-volt choking coil be switched in, the excess of pressure in the choking coil is 10,500, and 13,300 volts. This action of the self-induction can be explained as follows: when the self-induction is not switched in, the coils, or parts of conductors nearest to the supply main, exert a choking action when the current is turned on, so that the whole amount of excessive pressure is, so to speak, concentrated in these first portions of the coils. If, however, self-induction be switched in series with the machine, this self-induction takes up the excess of voltage. The self-induction coil can easily be so insulated that a disruptive discharge can not occur therein. The choking coil may be short-circuited by another movement of the switch after the starting has been effected. A single choking coil may be used for several machines, this single choking coil being only switched in when a machine is switched in or out.

The second patent is entitled "an auxiliary appliance for the prevention of the occurrence of excessive pressures on switching on and off electrical installations of high voltages; applicable also for testing purposes," and was granted to Siemens Brothers & Company, on behalf of the Siemens-Schuckert Works. The following are abstracts of the essential points covered by these patents, as given in the London *Electrician*, February 17:

Referring to the accompanying drawing, g represents a three-phase current generator, and n are the network conductors, from which the cables k are branched by means of the switches s. The auxiliary appliance consists of a transformer with three windings, of which w and w_2 have the same number of turns



SAFETY DEVICE FOR PREVENTING EXCESSIVE PRESSURE RISE IN ALTERNATING-CURRENT SYSTEMS.

and are connected in the same direction by means of switches s_1, s_2, respectively, before and after the main switches s to the cables k. The third winding w_3 of the transformer, on the other hand, which is advantageously arranged for low pressures, is connected to a non-inductive loading resistance r of suitable value. Assuming, in the first instance, that the winding w_3 is open, but that all the switches are closed, then only the magnetizing current of the transformer will flow in the equal windings w_1, w_2. As regards the conditions of magnetization, nothing will be altered if the winding w_3 be connected up with the resistance r. Practically the same pressure of the connecting points w_1, w_2 will still be maintained if the switches s (which are to be considered as combined to form a three-pole switch) are opened; in consequence, no sparks can be formed at the switches, and no oscillations can be produced in the cables. In the same way, dangerous oscillations in the cables will be prevented, if now the switches s_1 be opened, as sparks are produced at these switches the extent of which depend upon the resistance r. Such sparks, as is known, allow of no rapid oscillations, in contradistinction to the charging sparks produced on the switching in of unloaded cables. The application of the loading resistance therefore acts as a damper of oscillations.

The application of the arrangement, which can, of course, be applied to networks having any number of phases, will be as follows: if the unloaded cables k are to be separated from the network n, then, in the first instance, the switches s_1, s_2 of the auxiliary appliance are closed, one after the other; the switches s are then opened and the direct connection between the cables k and the network conductors n thereby broken; the switches s_1 are then opened whereby the cables k are deprived of their pressure, and, finally opening the switches s_2 the cables are separated from the auxiliary appliance. When connecting unloaded cables k to the network n the switches have to be manipulated in the reverse order by first closing s_2, then s_1, and by finally closing s. When the cables are connected to the mains direct, the switches s_1 and s_2 are opened one after the other and the auxiliary appliance thereby disconnected. The auxiliary appliance, described above, is also very suitable for testing cables under pressure. In this case the main switches s would be open or entirely dispensed with. If a higher pressure than that of the existing network pressure is to be used for the testing, then the translation ratio of the windings w_1 and w_2 is not made as before as 1:1, but is made to correspond with the intended testing pressure.

National Electric Light Association.

Several novel features will be introduced by the entertainment committee which will have charge of the entertainment of the guests at the convention of the National Electric Light Association, to be held at Denver and Colorado Springs, Col., June 6 to 11. The typical life of the western cowboy will be shown in a bronco-busting contest to be given in Denver during the week of the convention. The work of the different committees in charge is proceeding with much expedition, and the members of these committees express the opinion that this will be one of the most successful conventions that has ever been held by the association. A hurried canvass of the different cities which will be represented shows that the attendance will be greater than had been expected. Several special trains from eastern cities have been engaged by delegates, and a number of large parties are being organized to make the trip. The financial support for the convention will be all that could be desired. The finance committee is receiving liberal contributions from Colorado Springs and Denver.

Power-House and Single-Phase Car Equipment of the Indianapolis & Cincinnati Traction Company.

ANNOUNCEMENT has already been made of the opening to the public by the Indianapolis & Cincinnati Traction Company of the first road to be operated on the new alternating-current, single-phase system. The single-phase operation is, however, not the only interesting feature of the installation; the general engineering involved, and especially the equipment of the power-house, being worthy of careful attention.

POWER-HOUSE.

The 120 miles of railway are operated from a single power station. The station is located in Rushville, Ind., about forty miles from Indianapolis and about eighty miles from the other end of the completed line. The site is adjacent to the C. H. & D. Railway, with a connecting track from that road to the company's side track alongside the power station, which track in turn is connected to the main track of the operating company. This arrangement is convenient for ordinary business and will be especially useful whenever it becomes necessary to burn coal under the boilers (natural gas is now being used). It will be possible for the operating company to deliver coal from its own line or take it from the line of the C. H. & D. Railway Company, cars being shifted by electric power. The side track along the power station is built at a proper level for the dumping and crushing of coal, so that it can be handled by carrier and elevator, and fed under the boilers on chain grates without manual handling of any kind. A mill-race, from the stream known as "Flat Rock," runs along the east side of the power station and furnishes water for condensing and other purposes.

The station building is 113 feet by 128 feet 10 inches, and is of very heavy and substantial construction. The foundations are of concrete and the upper walls are of brick laid with cement mortar. The framework and roof structure are of steel. Floors are of concrete and a gravel asphalt roof is laid upon a concrete base with expanded metal, making the building entirely fireproof. The building is designed and constructed with a view to the installation of coal-crushing and automatic coal-handling machinery, with overhead bunkers feeding direct to the boiler grates. The coal bunkers and carriers have not yet been put in, but everything is prepared for their installation.

Foundations for the engines, boilers, pumps and other machinery are all of concrete. Stairways are made of either steel or concrete. The cellars and chambers for electric wires, cables, switches, transformers, protective apparatus, etc., are built according to the most modern practice and in the most substantial manner. The structural and architectural features of the building were designed by Sargent & Lundy, Chicago, Ill., the consulting engineers, and constructed under their supervision. The John A. Schumacker Company, of Indianapolis, was the general contractor, and the American Bridge Company furnished the larger part of the steel work.

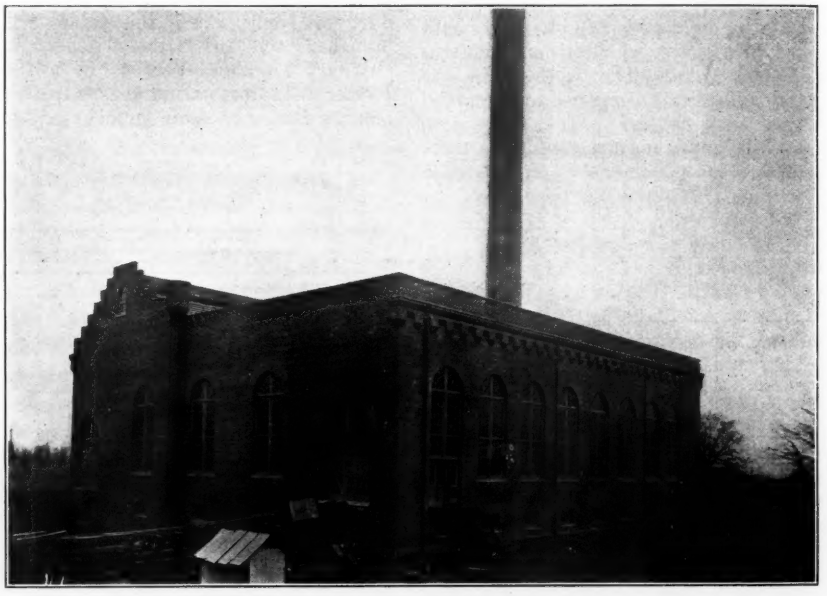
A concrete tunnel three feet six inches in diameter, running under the basement floor, conveys the water from the mill-race to the condensers, and a similarly constructed tunnel is provided to carry the water back to the mill-race, connecting at a point some 300 feet below the intake. The supply tunnel is provided with an intake crib which is equipped with an iron grill and removable screens.

At the east end of the power station, erected upon a heavy concrete base, is a well proportioned, self-supporting steel stack 180 feet high, entirely lined with firebrick. The inside diameter of the stack is eleven feet. It is of sufficient size to take care of eight 350-horse-power boilers, space for which is provided in the present building. The stack was constructed by the S. Freeman & Sons Manufacturing Company, of Racine, Wis.

The power-house is so framed and constructed that the west wall can be taken out without disturbing the other walls or the present steel framework, and the building extended to the west. For this purpose a space of over 200 feet has been reserved for extensions to accommodate the future needs of the company.

The present equipment includes three Babcock & Wilcox water-tube boilers of 350-horse-power capacity each. Each boiler contains in the setting a Babcock & Wilcox superheater proportioned for about 100 degrees of superheat. Space is provided in the building for five additional boilers of the same capacity, which will be installed as rapidly as additional power is required. Provision is made for the use of coal if at any time the supply of natural gas becomes exhausted. The boilers are now equipped with flat grates set in an extension furnace, but the setting is arranged so that chain grate stokers can be easily installed when the coal-handling apparatus is put in.

The boiler room is equipped with a large, open, exhaust feed-water heater of the Stilwell-Bierce make, and with two vertical "Atlantic type" feed pumps, built



POWER-HOUSE, INDIANAPOLIS & CINCINNATI TRACTION COMPANY.

by the Dean Brothers Steam Pump Works, of Indianapolis.

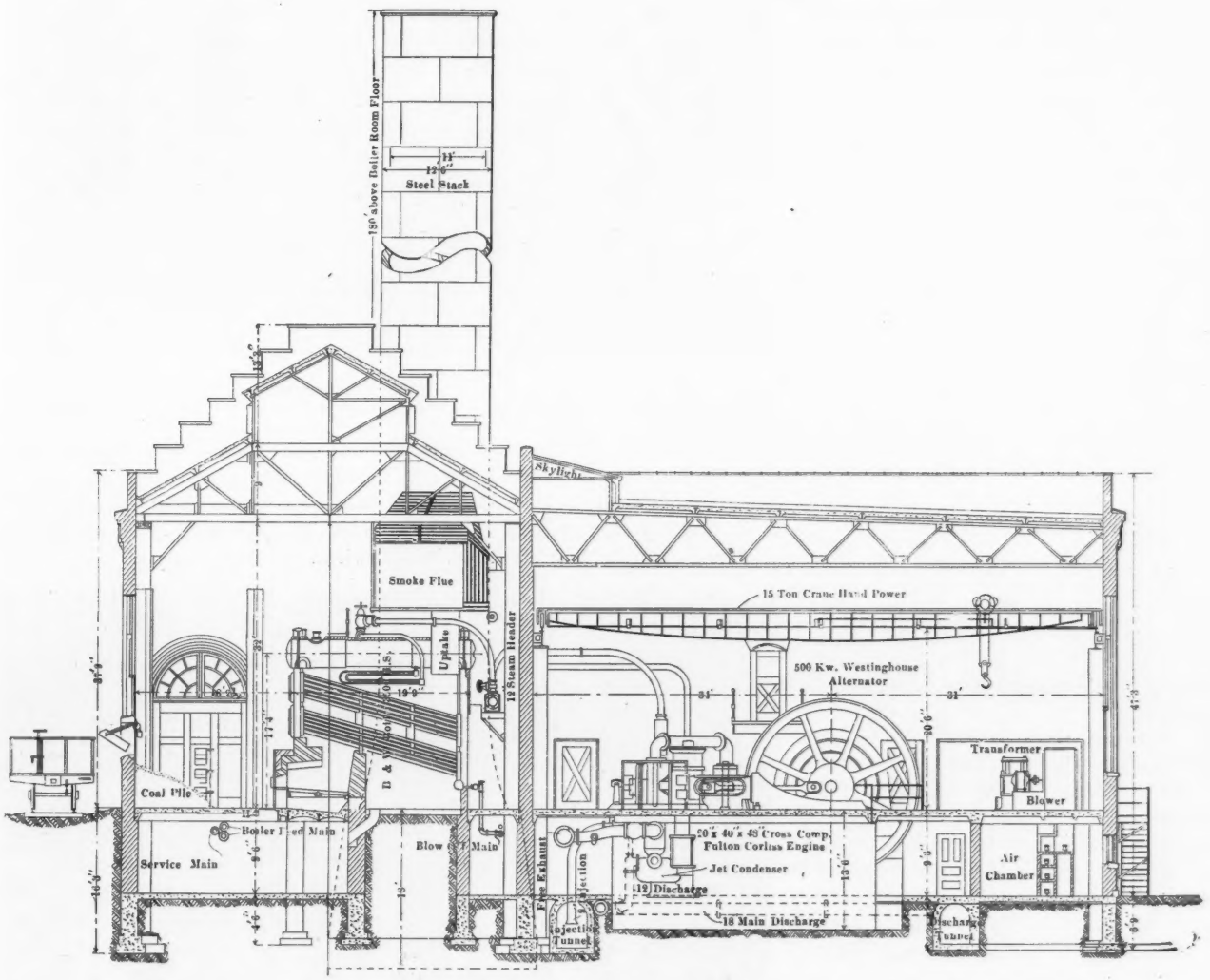
The engine room is provided with a traveling crane, built by the Northern Engineering Works, of Milwaukee, of sufficient capacity to handle all its machinery and which greatly simplifies the work of installation. The present generating equipment includes two 700-horse-power Corliss type, cross-compound, condensing engines, built by the Fulton Iron Works, of St. Louis, Mo. Each engine is equipped with an independent steam-driven jet condenser, made by the Dean Brothers Steam Pump Works. The condensers are set in the basement, but are arranged for operation from the main floor level.

Each engine is direct-connected to a 500-kilowatt, 2,300-volt, three-phase, twenty-five-cycle, Westinghouse revolving-field, alternating-current generator, running at a speed of ninety-four revolutions per minute. The engines are operated at a steam pressure of 140 pounds per square inch.

The generators are of standard Westinghouse construction. The frames of the stationary armatures are of cast iron and surround inner cores of laminated steel which are built up with overlapping joints so as to form a circular ring, slotted to receive the coils. The slots are of the partially closed type, and the coils are connected to give the three-phase relation. The field cores are formed of laminated punchings dove-tailed to a cast-iron spider. The field has thirty-two poles, each of which is wound with machine-formed coils. The field is separately excited. The generators will develop full load continuously under normal conditions with a temperature rise not exceeding thirty-five degrees centigrade above the surrounding air, and immediately following such a full load run will carry fifty per cent overload for a limited period with a temperature rise not exceeding fifty-five degrees centigrade. The generators have a close inherent regulation, but arrangement has been made to further control the voltage by means of Tirril regulators mounted on the switchboard. The present engine room provides sufficient space for the installation of two additional generating units.

Two exciter sets have been installed, one of which is driven by a Westinghouse compound steam engine, the other by a type C induction motor which, in turn, is driven from the main generators through transformers.

The generators are connected directly to two pairs of 250-kilowatt air-blast transformers which are connected according to the Scott three-phase, two-phase system, to transform the current from 2,300 volts, three-phase, to 33,000 volts, two-phase, at which higher potential it is delivered to the transformer stations along the line of the railway, and to the



TRANSVERSE SECTION OF POWER-HOUSE, INDIANAPOLIS & CINCINNATI TRACTION COMPANY.

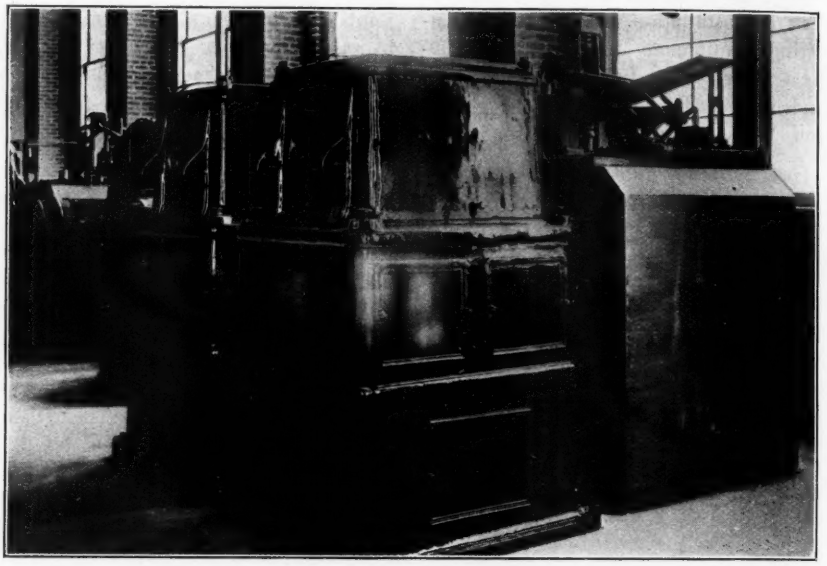
lowering transformers in the power-house which supply the portions of the road located in and near the city of Rushville. Air to cool these step-up transformers is furnished by a pair of ninety-inch fans, made by the Sturtevant Company, and driven by Westinghouse type C induction motors.

The air-blast transformers are connected in pairs and each pair is connected in turn with its own generating unit. The high-tension coils of the transformers are divided so that they may be connected for either 16,500 volts or 33,000 volts, while the low-tension winding is designed for 2,300 volts, the potential of the generators. The insulation between the high-tension coils and core was submitted to a test of 66,000 volts, alternating current, for one minute, and for the same length of time a potential of 4,600 volts was applied between the low-tension coils and core. These transformers are designed to carry full load for twenty-four hours with a temperature rise of twenty-five degrees centigrade above the temperature of the surrounding air, and after a full load run under these conditions each will carry an overload of forty per cent for two hours with a final temperature rise not exceeding fifty-five degrees centigrade. Their efficiencies are approximately as follows:

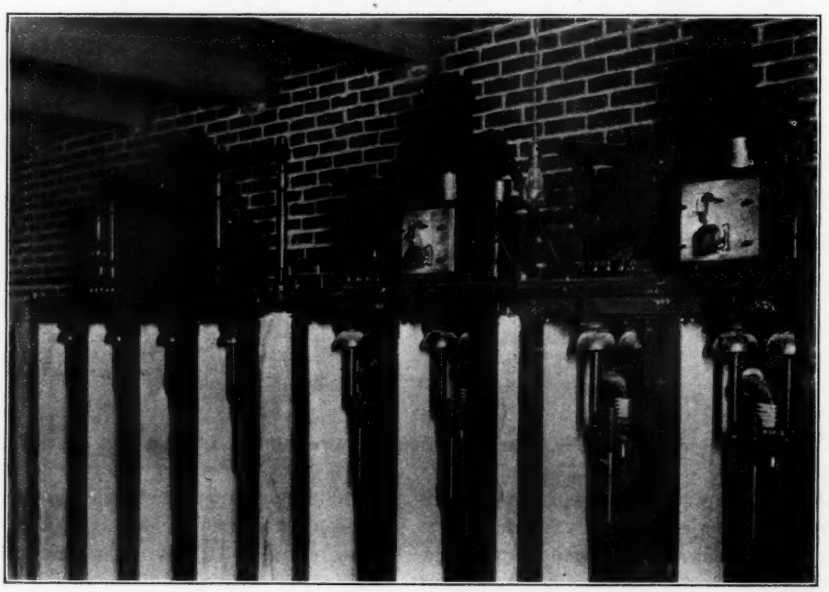
	Per Cent.
Full load	97.4
Three-quarter load	97.0
Half load	96.1
One-quarter load	92.8

Between the high-tension coils of the step-up transformers and the main bus-bars, 33,000-volt, oil-insulated, electrically operated, two-phase non-automatic switches have been installed. On each outgoing feeder leading to the transformer stations, a double-pole automatic switch of similar type has been inserted, and each outgoing feeder is also protected by disconnecting switches, which were made by the Westinghouse company in accordance with designs especially prepared by Sargent & Lundy.

The generators are connected in parallel. The operating panels are located in the main engine room, forming two switchboards of blue Vermont marble. The first board is composed of five panels and provided with apparatus for the control of the two exciter sets, the motors which drive the ventilating fans for the step-up transformers, and the ammeters, voltmeters, wattmeters, Tirril regulators, synchroscopes and switch-control mechanism for the two 500-kilowatt main generators. All the switches are electrically operated, current for this purpose being supplied by the exciter set. As, however, the generators are governed by Tirril regulators, it was thought wise to install a specially designed booster set in the switch operating circuit, in order that the electromotive force of the exciters may not be so reduced by the action of the Tirril regulators that the switch mechanism may fail to act; and in this way all possibility of failure has been overcome. The second switchboard is composed of twelve blue Vermont marble panels, designed to control the outgoing feeder circuits. Five of these panels are now blank, but will be equipped with the necessary apparatus when the operations of the road are more extended. The main bus-bars occupy a portion of the basement. They are mounted upon heavy insulators which are supported upon a masonry structure which is very heavy and substantial. Provision has been made so that the air from the transformer fans is carried through the bus-bar chamber. The bus-bars are arranged in a double set, each of which is protected by a disconnecting switch.



PAIR OF 250-KILOWATT, 2,300 TO 33,000-VOLT, WESTINGHOUSE AIR-BLAST TRANSFORMERS, IN ENGINE ROOM, POWER-HOUSE OF INDIANAPOLIS & CINCINNATI TRACTION COMPANY.



ELECTRICALLY OPERATED, OIL CIRCUIT-BREAKERS IN HIGH-TENSION CHAMBER OF POWER-HOUSE, INDIANAPOLIS & CINCINNATI TRACTION COMPANY.

The east end of the building constitutes what is called the high-tension chamber, and is divided into four floors. The basement contains the bus-bars which are mounted similarly to those leading from the generators, together with the

instrument transformers. On the main floor are installed the oil-insulated, electrically operated, high-potential switches which are controlled from the panels in the engine room, the lowering transformers from which the 550-volt alternating-current trolley line in the city of Rushville is operated, the lowering transformers—33,000 volts to 3,300 volts—which feed the sections of the trolley immediately next to Rushville on either side, the lowering transformers for the operation of the motors which drive one exciter and the ventilating fans in the engine room, and the static interrupters for the protection of the lowering transformers.

On the third floor have been installed the static interrupters which are connected to the main outgoing feeder lines, while the low-equivalent lightning arresters are mounted upon the fourth floor of the high-tension chamber.

It will be noted that all switching is done on the high-tension side.

The general plan of operation is the transmission of alternating current over single-phase circuits at 33,000 volts to transformer stations which are located every ten or twelve miles along the road, where the potential is reduced to 3,300 volts and connected direct to the trolley circuit. The transformer stations require no attention, as the feeder lines are all controlled from the main power-house, and no moving apparatus is installed in the transformer houses. Because of the high potential at which the current is transmitted and fed to the trolley circuit, no auxiliary feeders are necessary, and the total expenditure in copper is exceedingly low. The possibility of this saving constitutes one of the most important advantages of the alternating-current single-phase railway system.

CAR EQUIPMENT.

The present car equipment consists of ten passenger cars constructed by the St. Louis Car Company. These cars measure fifty-five feet over all, and are each divided into three compartments, the first of which is nine feet ten inches long and is arranged for the accommodation of baggage. It is provided with doors opening on either side. In front of this baggage compartment and separated from it by a strong railing is the space allotted for the motorman. The middle compartment has a seating capacity for sixteen people and is fitted up as a smoker. The main compartment occupies the other end of the car and contains seating capacity for thirty-eight people.

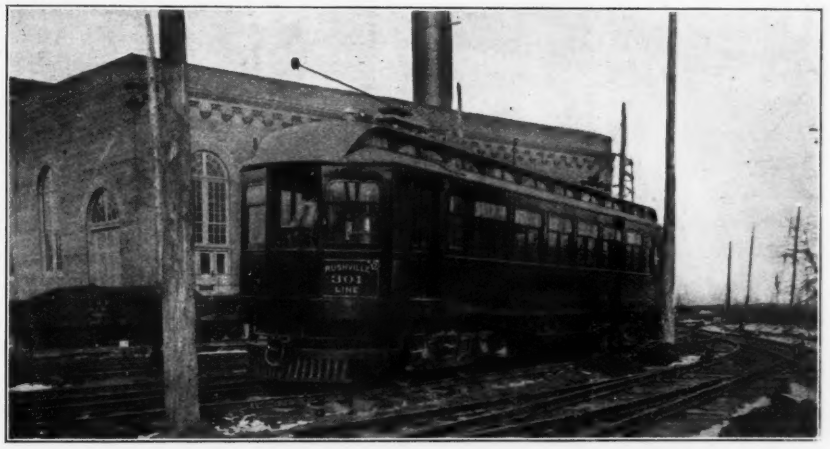
All the seats have reversible backs and are upholstered and covered with plush. Under normal conditions the cars will operate always in the same direction, though the equipment is such that they may be controlled from either end. At the rear of the car a vestibule is provided with space for ingress and egress of passengers.

The cars are finely finished in mahogany. The windows are of plate glass with art glass in the upper part and also in the ventilators. The toilet room is placed in the rear at the left side, so as not to obstruct the view of passengers entering the car at the right side. The cars are heated with the Smith hot-water heaters, placed in the front compartment and under direct charge of the motorman, with pipe running through all the car.

The framework is especially substantial, the floor and lower part being made of steel with steel ribs running from the top. The roof is covered with sheet copper. The finish of the car inside and out is very handsome and in every respect the work is fully equal, if not superior, to anything yet done for electric service. The trucks were made by the Baldwin Locomotive Works, and are of the M. C. B. type, with steel-tired wheels thirty-six inches in diameter. The axles are six inches in diameter and have five-inch by nine-inch journals.

As the cars of this line must be operated over the tracks of the local railway companies in the city of Indianapolis, which are all supplied with direct current, it was necessary in their equipment to make provision for operation on either direct or alternating current. Furthermore, as it was not considered advisable to use a high-potential trolley circuit within the limits of the town of Rushville, it became necessary to provide for the use of two alternating-current trolley voltages. The main portion of the trolley circuit is supplied with 3,300-volt, single-phase alternating current. The total arrangement, therefore, includes operation at 550 volts, direct current, within the limits of Indianapolis and 550 volts, alternating current, in Rushville, and 3,300 volts, alternating current, on the other sections of the line. Because of this complicated service, it seemed advisable to pass by the attractive and economical features of control by induction regulators and to adopt the rheostatic system on account of its simplicity and adaptability to both alternating and direct-current operation.

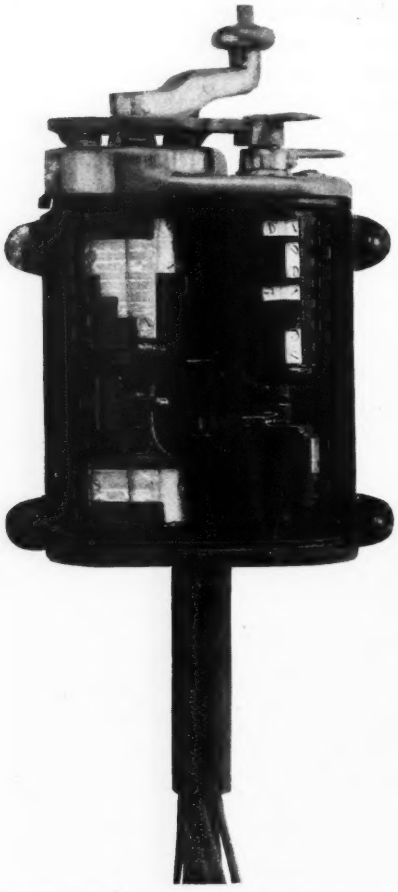
The car equipment includes four No. 106-A alternating-current, commutator-type, series-wound railway motors, rated at seventy-five horse-power each; one main autotransformer wound for a primary potential of 550, 1,650 and 3,300 volts and for a secondary potential of approximately 250 volts; reversing switch; motor cut-out switch; commutator or change-over switch to throw the equipment from alternating current to direct current and *vice versa;* a complete unit switch system of multiple control with two operating controllers arranged for the operation of the cars either singly or in trains; rheostats or current diverters for use on either alternating or direct-current circuits; air-compressors direct-connected to both an alternating-current and direct-current series-wound motor; air reservoirs; two sets of storage batteries consisting of seven cells each; complete Westinghouse air-brake equipment with control valve on either platform; complete hand-brake equipment with controlling lever on one



CAR, INDIANAPOLIS & CINCINNATI TRACTION COMPANY.

platform; one wheel trolley for low-potential service; and one bow type trolley for high-potential service.

The motors, which are wound for 250 volts, are connected four in series for direct-current service, and four in parallel



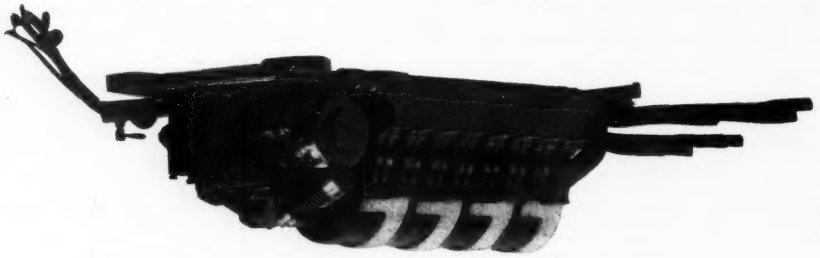
MASTER CONTROLLER ON CAR, INDIANAPOLIS & CINCINNATI TRACTION COMPANY.

for alternating-current service. The motors are geared for a maximum speed of forty-five miles per hour for local service.

The frames of the motors are made of cast steel surrounding a circular core built up of laminated punchings, which form four inwardly projecting poles. In addition to the main series coils which are mounted direct upon the poles, auxiliary coils are provided which are threaded through partially closed slots in the pole-faces. The circular casting is made in one piece and is closed by circular end-pieces, which form supports for the armature bearings. The bearings are mounted in separate housings, a construction similar to that adopted as standard in the latest practice of the Westinghouse company in the construction of direct-current railway motors. Lubrication is by oil and waste. The axle bearings are supported by heavy lugs which project from the motor frame. The armature is of the slotted drum type, with machine-formed coils imbedded in open slots and held in place by retaining-wedges. Though rated at seventy-five horse-power each, these motors are guaranteed to develop 100 horse-power at normal potential on either direct or alternating current without injurious sparking.

The unit switch system of multiple control as adopted is the standard Westinghouse equipment modified to suit the double operation by alternating and direct current. The unit switches are arranged in groups, one of eight and one of four units, which are mounted under the floor of the car. They are operated by compressed air which, in turn, is controlled by magnet valves actuated by current from the storage batteries. The operating controllers are mounted one upon each platform and are very small and compact.

The current reverser is of the reciprocating type, generally used with the Westinghouse system of multiple control. The main autotransformer is of the shell form, air-cooled type. Before shipment it was subjected to a test of 10,000 volts between winding and iron, and was operated at double potential for ten minutes. It is designed for operation at twenty-five cycles, a frequency which has been adopted as standard for single-phase railway service.



REVERSER ON CAR, INDIANAPOLIS & CINCINNATI TRACTION COMPANY.

A peculiar form of bow trolley designed for high-potential alternating-current circuits is used. The trolley is mounted upon a thoroughly insulated platform and is raised, lowered and controlled by the motorman by means of compressed air. There is therefore no danger at any time of contact with live parts of the trolley. The bow carries a large, flat aluminum shoe, which makes contact with the underside of the trolley wire.

For low-potential service, whether alternating or direct current, a modification of the Union Standard trolley is provided, as the bow type could not be used in the city of Indianapolis.

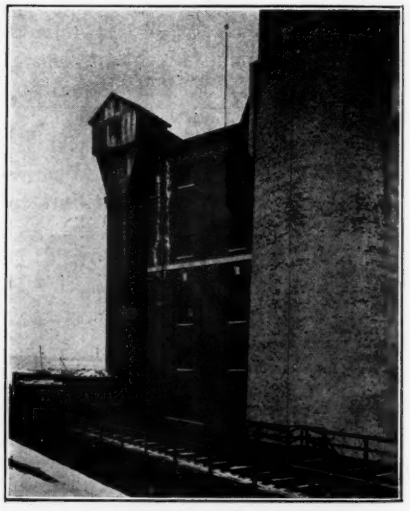
A novel feature of the equipment of these cars was installed at the suggestion of Mr. A. A. Anderson, general superintendent of the road. It consists of a speaking tube connecting the motorman's position with the rear platform, so that the conductor and motorman may talk with each other at any time.

The entire electrical equipment of these cars was furnished by the Westinghouse Electric and Manufacturing Company and installed under the supervision of Sargent & Lundy, of Chicago, the consulting engineers.

POWER-HOUSE FUEL SUPPLY.

A MODERN COAL-HANDLING PLANT.

A very interesting and modern equipment of coal-handling machinery is that recently installed in the new power-house



COAL ELEVATOR AT CHRISTIAN STREET POWER-HOUSE, PHILADELPHIA.

of the Philadelphia Electric Company, located at Christian street wharf, Schuylkill river, Philadelphia, by the Link-Belt Engineering Company, of Philadelphia.

The boiler house, which is a double-decked one, stands on low ground adjacent to the Pennsylvania Railroad tracks and has sufficient floor space to accommodate sixteen 650-horse-power boilers on each floor. At the present time twelve boilers have been installed on the first floor, nine of which are in use and consume on an average of 100 tons of bituminous coal per day of twenty-four hours.

Coal cars are shifted into the yard on

a double-track trestle, elevated twenty-seven feet above the basement of the boiler house, at which point they drop their contents into a steel hopper spanning both tracks. This hopper is fitted with a Link-Belt reciprocating feeder which controls the delivery of lump anthracite or bituminous with masses thirty inches and larger in diameter as readily as it does the delivery of buckwheat coal. This is rendered possible by the fact that the rate of delivery is entirely independent of the size of the discharge opening in the hopper, and that the opening can therefore be made large enough to suit the lumps to be handled.

By means of the reciprocating feeder coal is automatically transferred in uniform quantities and regularly to a Link-Belt inserted steel tooth crusher, and besides dispensing with the labor of one man at the hopper, to assist and regulate the flow of coal, it prevents overloading the machine and consequent dangers.

The crusher is mounted on a cast-iron frame and enclosed by a steel housing. It is made with two charcoal iron, chilled rolls, one of which is mounted in spring bearings to allow it to yield to a piece of iron or other hard article that may enter the machine. The crusher and feeder are driven by a fifteen-horse-power motor.

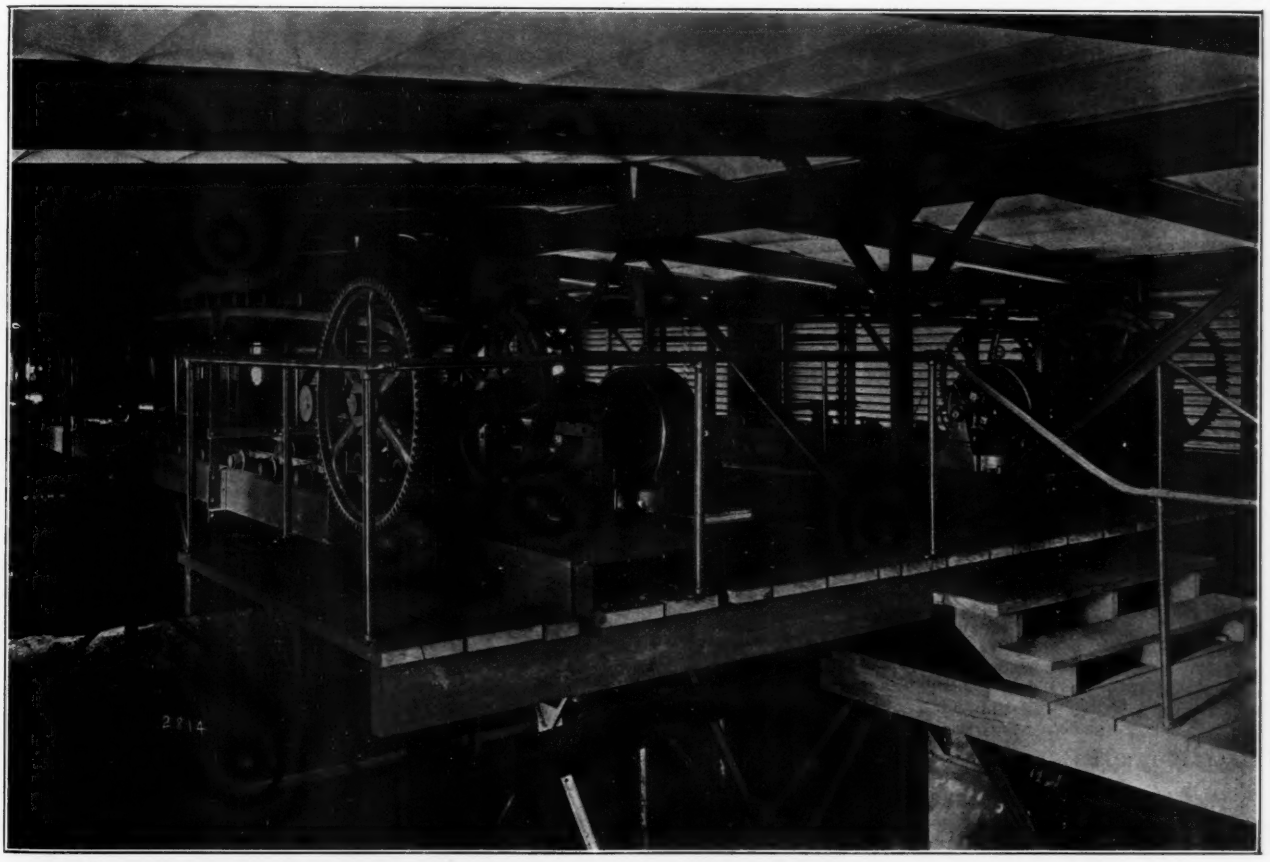
From the crusher coal is spouted to the lower horizontal run of a Link-Belt patented gravity discharge elevator and conveyer consisting of two strands of forged chain with steel buckets attached at intervals. The vertical run of the machine is supported on foundations by a steel tower sheathed with corrugated iron.

After receiving coal from the crusher the gravity discharge elevator and conveyer conveys it thirty feet horizontally, then 106 feet vertically, and then sixty feet horizontally directly under the roof of the boiler house. A thirty-horse-power motor is used for operating this machine.

On the upper horizontal run coal is discharged into either one of two roller flight conveyers, at present only 155 feet centres each, but designed to permit an increase in length when the boiler house is extended. Each of these machines is driven by a fifteen-horse-power motor and consists of suspended roller flights attached at intervals to closed-joint link-belting. On the conveying run the rollers serve to suspend the flights, so that they will not come in contact with the trough, thus preventing noise and reducing wear to the minimum. The coal is distributed in the 2,000-ton pocket through Link-Belt rack and pinion discharge gates with which the conveyer troughs are fitted.

The coal bunker is equipped with eight chutes which are arranged to spout the coal in front of the boilers on first and second floors.

While this machinery is guaranteed to handle 100 tons per hour, the crusher easily reduces run-of-mine bituminous coal to about three-inch cubes or smaller at the rate of 130 tons per hour, the elevator and conveyer having capacity to handle the crushed coal at the same rate.



ROLLER-FLIGHT CONVEYERS IN CHRISTIAN STREET POWER-HOUSE, PHILADELPHIA.

Before the installation of the elevating and conveying machinery coal was unloaded by a crane equipped with a clam-shell bucket to a pile about 200 yards from the boiler house and then reloaded by the same crane into trolley cars and carried to the boiler house. This operation required the services of six men every day, whereas the present equipment necessitates the employment of but one man one hour each day to keep the bunker well supplied with coal and has the further advantage of always having in reserve enough coal to meet all demands of the boilers for twenty days.

BOOK REVIEWS.

"The Beginner's Guide to the Lathe." Model Engineer Series No. 25. Percival Marshall & Company. Paper. 76 pages. 5 by 7 inches. Illustrated. Supplied by the ELECTRICAL REVIEW at 25 cents.

This is one of the Model Engineer Series, and, as its title indicates, is devoted to lathe work.

"The Study of Electricity for Beginners." Norman H. Schneider. New York. Spon & Chamberlain. Paper. 88 pages. 4¾ by 7¼ inches. Illustrated. Supplied by the ELECTRICAL REVIEW at 25 cents.

This is a non-technical book, and describes in simple language the elementary facts of electrical science, and shows the application of some of the fundamental laws.

"Suction Gas." Oswald H. Haenssgen. Cincinnati. Gas Engine Publishing Company. Cloth. 88 pages. 5¼ by 7 inches. Illustrated. Supplied by the ELECTRICAL REVIEW at $1.

This book describes and illustrates the Dowson gas producer, gives directions for operating the same, tells of results obtained in Europe, and discusses the advantages of suction gas, and of combined Dowson and suction gas plants.

"Electrical Circuits and Diagrams Illustrated and Explained." Norman H. Schneider. New York. Spon & Chamberlain. Paper. 72 pages. 4¾ by 7¼ inches. Illustrated. Supplied by the ELECTRICAL REVIEW at 25 cents.

This little book gives the diagrams in common use in electrical work and describes such, when necessary. These diagrams include everything from annunciator work to wireless telegraphy, and give the different methods of connecting up in use in the various applications.

"Hyde's Telephone Troubles and How to Find Them." Milwaukee. W. H. Hyde & Company. Paper. 56 pages. 5 by 6½ inches. Illustrated. Supplied by the ELECTRICAL REVIEW at 25 cents.

This is the eleventh edition of this valuable little book on telephone troubles. It has been revised and brought up to date, and contains a quantity of new matter on low and high-frequency systems for four-party selective lines, and on methods of testing and repairing toll lines, specifications for inside wiring, the use of condensers, and rural lines.

"Ferric and Heliographic Processes." George E. Brown. New York. Tennant & Ward. Cloth. 149 pages. 5 by 7½ inches. Illustrated. Supplied by the ELECTRICAL REVIEW at $1.

This useful little book describes the various processes for reproducing drawings. All of the well-known methods are explained, and formulæ given for the various processes. Samples or prints are shown, and directions are given for preparing of the paper and for printing and fixing a plan of a suitable laboratory in which this work may be carried out is offered.

"How to Install Electric Bells, Annunciators and Fire Alarms." Norman H. Schneider. New York. Spon & Chamberlain. Paper. 64 pages. 4¾ by 7¼ inches. Illustrated. Supplied by the ELECTRICAL REVIEW at 25 cents.

In this book the principle of the electric bell is explained, and the methods of installing bells and the batteries used in the work are described. The common types of thermostat are also described and directions are given for their installation. The book deals, as well, with the ordinary forms of annunciators.

"Dry Batteries." A Dry Battery Expert. New York. Spon & Chamberlain. Paper. 60 pages. 4¾ by 7¼ inches. Illustrated. Supplied by the ELECTRICAL REVIEW at 25 cents.

The different types of dry cells in use are here described, methods of manufacturing explained, and the tools useful in this work shown. A number of useful hints for conducting the work are given, as well as formulæ for preparing the chemicals. Methods of connecting the cells for different purposes are explained.

"Short Course in Alternating Currents." Fitzhugh Townsend. New York. D. Van Nostrand Company. Paper. 32 pages. 5½ by 8½ inches. Illustrated. Supplied by the ELECTRICAL REVIEW at 75 cents.

This is a synopsis of the course in alternating-current laboratory work which is now given to the graduating class in mechanical engineering at Columbia University. Experiments illustrating the properties of alternating-current circuits, and tests of transformers and other alternating-current apparatus, both for illustrating the physical principles and for commercial uses, are given.

"The Art of Generating Gear Teeth." Howard A. Coombs. New York. D. Van Nostrand Company. Boards. 129 pages. 4¾ by 6 inches. 37 illustrations. Supplied by the ELECTRICAL REVIEW at 50 cents.

This book consists of a number of papers which have been reprinted from the *American Machinist*. It contains six chapters, which are devoted to the theory of tooth curves, formation of gear teeth, the first generating machines, American generating machines, modern generating machines, and generating other forms of teeth. The theory of gearing is gone into quite extensively, and the history of tooth generation is fully described.

"Cyclopædia of Applied Electricity." Five volumes. Chicago. American School of Correspondence at Armour Institute of Technology. Three-quarters leather. 424, 422, 410, 490, 398 + 19 pages, respectively. 7 by 9¾ inches. Illustrated. Supplied by the ELECTRICAL REVIEW at $18.

This set of books forms one of the most complete libraries of applied electricity that has yet been compiled. It has been prepared by men widely known as authorities in electrical matters, as well as teachers. The work, as a whole, is intended for students who have not had a technical education nor advanced training in mathematics. Mathematical analyses are avoided as far as possible. The subject matter of the work is explained in simple language, in connection with a large number of diagrams prepared especially for the text. Where the matter dealt with relates to particular machines, illustrations of standard American types are used freely, thus familiarizing the student with the appearance of the machines used in actual work. While the books have been designed to be used as text-books, they are arranged to form a convenient and useful reference work, and for this purpose a complete subject index has been compiled. In addition, each volume contains a number of practical examples dealing with the different subjects taken up, and there is a list of review questions, by means of which the reader can test the knowledge which he has obtained from his study. The particular value of these books to the student may be judged, in part, by the standing of certain of the authors. Of these we may mention Professor F. B. Crocker, of Columbia University; Professor William Esty, of Lehigh University; Professor D. C. Jackson, of the University of Wisconsin, and Professor Louis Derr, of the Massachusetts Institute of Technology. Vol. i deals with current measurements, wiring and telegraphy. Not too much time is spent in explaining the elementary phenomena, with which every one is to-day familiar. Electrical resistance is defined. Methods of determining resistance and tables of copper wire are given, showing to the student that the knowledge which he is obtaining has practical value. The different types of measuring instruments are described, and their use explained. Under "electric wiring," methods of installing electrical apparatus, the necessary precautions which must be taken for both inside and outside work, and directions for computing lines, are explained. A brief chapter tells how bell wiring and annunciator work should be done. The section on the telegraph describes the various systems and apparatus, and explains the methods of operating. This volume concludes with a brief chapter on wireless telegraphy. Vol. ii deals with dynamos, motors and storage batteries. This volume first ex-

plains the physical theory of the dynamo. The different elementary types are described, their behavior being illustrated by characteristic curves, which are explained. A chapter on dynamo designs shows how this important work should be approached, and this is followed with descriptions of standard machines. A section on direct-current motors explains the theory of the motor, and the characteristics of the various types. In the section on storage batteries, the theory of the chemical action is stated, and the different types of cell are described. Directions are given for charging and for caring for the cells, for locating trouble and remedying faults, and the methods of using batteries for various purposes are explained. Vol. iii takes up electric lighting, electric railways and electric power stations. The section on electric lighting describes the incandescent and arc lamps, giving methods of manufacturing the former, and then passes to special types of lamps, such as the Nernst and the flaming arc. After explaining systems of distribution and methods of street lighting, photometric methods are described. The section on electric railways deals with this subject in the same thorough manner, describing first the railway motor and its accessory appliances. Distributing systems are described, and methods of locating faults. The chapter on railways is followed by two long and valuable chapters on the management of dynamo-electric machinery. Both of these give full instructions for caring for the plant. The last chapter in this book deals with power stations, showing the method of location, describing the different types of machinery used and the method of placing the machinery in the buildings. Vol. iv deals with alternating currents and power transmission. The first part of this forms a very satisfactory non-mathematical treatment of alternating-current theory. The author has spared no pains to make this important branch of electrical theory clear and understandable to the reader, and he has put the subject in such a way as to interest and convince him. Following the theory, the different types of alternating-current machines are described. The final section of this volume deals with power transmission, and gives practical methods for calculating lines, and instructions for arranging the conductors. A short chapter in this section describes and explains the theory of the Cooper Hewitt mercury vapor rectifier. Vol. v is a full treatise on telephony. The theory of sound transmission is explained, and the means by which air vibrations set up electric currents, which reproduce the sound at a distant point, is given. The different types of telephone instruments are also described. The line work is explained, and conduits, manholes, cables and switchboards are all dealt with satisfactorily. Following the discussion of the manual system is a description of automatic systems, and a short chapter on wireless telephony. This volume contains the subject index. The cyclopædia as a whole, as the above brief digest shows, forms a complete reference work. Besides the large amount of valuable information which is usually found in text-books, it gives many short-cut, practical methods which have been developed by practising engineers to facilitate calculations. The practical value of the subject in hand is always kept in view, so that the student never feels that he is wasting his time over matters that will never be useful to him.

Single-Phase Repulsion Motor Driving a Pump.

A new condenser has been placed in the generating station of the Burton-upon-Trent (England) corporation, for condensing the steam from the new 500-kilowatt set. Both the water-circulating pump and the air pump are driven by a Fynn single-phase repulsion motor. The latter is driven at 135 revolutions per minute, through gearing, while the former is coupled direct to the motor, which runs at 1,440 revolutions per minute. The length of circulating pipe which draws from and delivers water to the river Trent is 308 feet. The height above normal river level is seventeen feet. According to the specifications, the condensers had to deal with 13,500 pounds of steam per hour to give a vacuum of twenty-seven inches, with circulating water at a temperature of not more than sixty degrees Fahrenheit.

The motor is rated at fourteen horse-power, with an overload of about forty per cent. The stator is constructed on lines similar to those of the stator of an ordinary three-phase motor, while the rotor is generally similar to the armature of a rotary converter. It has two interconnected windings on it, the free ends of one being connected to slip rings, while the ends of the coils of the other are connected up to a commutator. The motor is started as follows: after closing the main switch putting the current on the stator windings, the starting switch is put on the first notch of the resistance in circuit with the brushes on the commutator side of the machine. The motor, driving the condensing plant, reached, in five seconds, a speed on the first notch of about 1,060 revolutions per minute. There are thirteen resistance notches, the speed rising to full as the switch moves over these. The slip rings are then short-circuited by pushing in a projecting knob on the spur-wheel end of the motor shaft. The starting switch is then moved back to the first position, and all of the brushes bearing on the slip rings are raised by means of a small lever handle at the same time. The motor may be started and brought up to full speed in about one minute. Commutation is said to be sparkless under all conditions. The starting current is just equal to full-load current, and is eighty-two amperes. The makers offered to guarantee an efficiency of eighty-three per cent, but as a special request was made for a higher power-factor, the latter was raised to eighty per cent, causing a slight reduction in the efficiency. Characteristic curves show that neither the efficiency nor the power-factor varies much from eighty per cent between a load of nine and nineteen horse-power.

The motor is not arranged for reversing, it not being necessary in this plant. When it is desirable to reverse the motor, as is generally the case, the stator is provided with a second winding in quadrature with the first winding. These two are connected in series, and when it is desired to change the direction of rotation, one of the windings is reversed, thus shifting the stator field with reference to the brushes.

In the large sizes of Fynn motors—from fifty horse-power upward—and in the Fynn traction motors, a peculiar method of self-excitation is provided, which enables the motor to work at all loads at a higher power-factor.

This is thought to be the first application of a repulsion motor to driving the pumps for a condenser. It is said, also, to be the second Fynn motor which has been put in operation in England.

The "Brooklyn Edison" for February, published by the Edison Electric Illuminating Company, of Brooklyn, N. Y., contains an editorial on the prophecy made by Thomas A. Edison, in 1878, when he said he could light the lower part of New York city from one machine. The editorial shows how this prophecy has been fulfilled. A poem entitled the "Age of Light" is printed on the front cover. The body of the magazine is devoted to the applications of the incandescent light to advertising and other uses.

Reviews of Current Engineering and Scientific Literature.

Homopolar Dynamos.

A description is here given of one of the homopolar dynamos which was designed and constructed some years ago by the author, Mr. A. H. Finley. This machine was built up of twenty-four segments, and had twelve pairs of collecting rings. It gives twelve volts at 750 revolutions, and twenty-four volts at 1,500 revolutions. It is self-exciting, the field winding being divided into two sections to permit the two speeds. When the machine was first built, there was considerable end thrust, but it was overcome by adjusting the armature. The machine is of the double-disc type, the armature segments consisting of two iron radial sectors connected together at the bottom by a copper strip, and at their outer ends to the collecting rings. The copper connecting bar passes through the central pole. The brushes used are flexible bands sliding in grooves on the rings, and have about a ninety-degree arc of contact. Each unit of the armature consists of two segments and two rings. They were all connected in series through the brushes and the stationary conductors. A second type of machine, which has been patented by the author, is also described. This has a solid armature, and is provided with armature and field magnet conductors in slots or tunnels close to the air-gap. The conductors passing through the field magnet are for connecting the armature conductors in series through the brushes and rings. The object of placing the field magnet conductors so near the air-gap is given as follows: "if any of the magnetic flux is caused to rotate, by reason of the rotation of the armature, then such flux-cutting return conductors will set up an electromotive force in such conductors in the opposite direction to that of the electromotive force in the generating conductors. Such electromotive force will help that of the generating conductors when the generating and return conductors are connected by means of a collector ring and brushes." It is also claimed that the armature reaction will be neutralized by the currents flowing in the return conductors, when arranged close to the generating conductors. In this machine it was considered sufficient to connect several armature conductors, equally spaced, to each ring, to do away with the trouble due to the currents' change in direction in the ring when flowing to the brush or brushes. It is suggested that this type of machine could be used in the alternating-current series motor.—*Abstracted from the Electrical Review (London), February* 24.

Eddy Current Losses in Massive Pole-Shoes.

A careful study of the effect of the eddy current losses in the pole-shoes of dynamo-electric machinery has been made by Herr Reinhold Rüdenberg. As the result of this work, the following equation is given for the energy losses taking place in the pole-shoe:

$$W_0 = \frac{1}{8\pi} v \sqrt{\frac{v\, t_1}{s\, \mu}} \left(B_0^2 \cdot 10^{-7} \right)$$

In this equation, W_0 represents the energy loss in watts; v is the velocity of motion of the armature teeth past the pole-face; s is the resistivity of the pole material; t is the pitch of the slots expressed in centimetres, and v in centimetres per second; b represents the amplitude of the variation in flux density produced by the armature teeth. Applying this formula to a certain class of machines given in Arnold's book on continuous-current machines, the author determines the eddy current loss in the pole-faces for a large number of different machines having different types of pole-face. A machine rated at one and one-half kilowatts showed a loss of 119 watts in the pole-face when the pole-shoe was constructed of sheet iron. The loss amounted to eighteen watts when cast steel was used. A machine rated at twenty-five kilowatts showed a loss of 8.2 per cent in the pole-shoes. The pole-face was made up of sheet iron. The velocity of the armature teeth in this case was fifteen metres per second. A machine rated at 100 kilowatts, in which the velocity of the teeth was 10.7 metres per second, showed a loss of 3,140 watts in the sheet-iron pole-faces. A 500-kilowatt machine, in which the speed of the armature teeth was 22.2 metres per second, showed a loss of 3,000 watts when the pole-face was of cast steel. A machine with a similar rating, in which the velocity of the teeth was 12.5 metres per second, showed a loss of 5,000 watts when the pole-face was formed of sheet iron. A machine rated at 1,000 kilowatts, in which the speed was 16.5 metres per second, showed a loss of 3,900 watts, the pole-face being of cast iron.—*Translated and abstracted from the Elektrotechnische Zeitschrift (Berlin), February.*

An Enclosed Mercury Reversing Commutator.

The ordinary mercury cup reversing commutator is one of the most common pieces of apparatus to be found in the physical laboratory. It has, nevertheless, some serious objections, in spite of its simplicity. To overcome these objections the following ingenious arrangement has been made by Herr J. J. T. Chabot. The usual form of rectangular base is retained, with the rocking table above it. In place of the six mercury cups upon the base there are six brass terminal bushings on the rocking table. These are cross-connected in the usual way and are attached to four fixed terminals on the base by means of flexible conducting cord. The brass terminals on the rocking table are arranged in two rows of three each, and to each is attached a commutating tube. This tube has three legs and a neck. All the legs are filled nearly full of mercury. Through the bottom of each projects a conducting wire of platinum. These wires are clamped in the brass terminal bushings, thus serving for good electrical connection and to hold the tube in place. When the rocking table is placed in a horizontal position, it is held by a catch, and as the mercury in the legs of the tubes does not come up to the top, the circuit is broken. However, when the table is tilted one way or the other, the mercury from the upper leg flows over and closes the circuit between the centre and the lower leg of each tube. The reverse action takes place when rocked in the other direction. To avoid oxidation of the mercury, the tube may be filled with some inert gas, such as nitrogen, or it may be exhausted and sealed. This device is suitable for commutating fairly strong currents of ten amperes or more.—*Translated and abstracted from the Physikalische Zeitschrift (Leipsic), February* 15.

Variations in One Period of the Luminous Flux Emitted by an Alternating-Current Arc.

A very interesting study has been made by M. C. Léonard of the variations in the luminous flux or light given out by the alternating-current arc during the

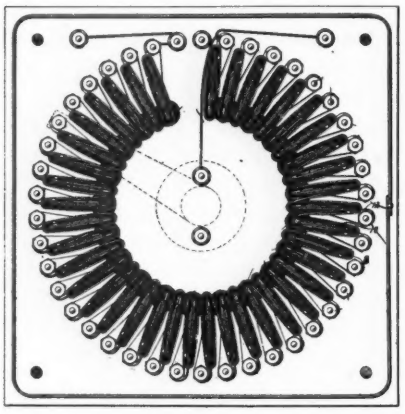
different phases of the arc. The results of this research are here given. Considering the subject generally, light is emitted from four parts of the arc: first, the crater of the positive carbon; second, the crater of the negative carbon; third, the arc or vapor column itself; fourth, from the incandescent tips of the carbons. The most important source of light is the crater of the positive carbon, the others following in the order named. In order to investigate the variations in luminous radiation, the arc was placed within a parabolic mirror, which focused the light upon a white screen. The light radiated from this screen was allowed to fall upon the photometer screen, and between the two was placed a rotating disc having a slot cut in one side. This disc was driven by a synchronous motor. The only light falling upon the photometer screen passed through the slot, and by varying the position either of the photometer screen or of the rotating disc respective to its armature, the screen could be illuminated by the light of the arc for any particular instant. The duration of this illumination was only about one-seven-hundredth of a second. Considering the variations of the luminous flux, the following deductions are made: the frequency of the variation of the total flux is double that of the frequency of the alternating current. The total luminous flux does not fall to zero with the current. There is apparently a slight phase displacement, equal to about one-thirty-second of the period of the current, between the minimum total luminous flux and the zero value of voltage or of current. There is no appreciable phase displacement between the maximum values of the curves showing the variation of the luminous flux and of current. The relative variation of the total luminous flux is sixty-four per cent. Passing to a consideration of the radiation in the lower hemisphere, the following was found to be true: the frequency of the variation of the luminous flux in the lower hemisphere is equal to that of the current. The phase displacement between the minimum luminous flux and the point where the voltage is zero is about one-forty-eighth of a period. The relative variation of luminous flux is 120 per cent—about double that of the total flux. Separating the flux into its components, with regard to the sources of light, the following is true: the luminous flux emitted by the incandescent extremities of the carbon is sensibly constant. The flux emitted by the arc proper is small in the normal arc, and has a frequency double that of the current. The luminous flux given by the positive crater of the lower carbon has a frequency equal to that of the current. The luminous flux emitted at the positive crater of the upper carbon has the same frequency as the latter, but is displaced with reference to it by half a period. The luminous flux due to the negative craters has the same frequency as that due to the positive craters, but is displaced with respect to the latter by half a period. In studying the arc, the author was led to divide the luminous arc into three parts: first, a small surface where a violet color predominates, forming a horizontal zone which is lighted by the arc proper, and, in part, by the incandescence of the carbons. The variations in the luminous flux reaching this zone are not easily perceived by the eye. The second zone extends up from the first, and has about double its width. In this area the eye easily perceives the variation of light. The third zone is that situated below the horizontal zone, and the phenomena there are similar to those in the second.—*Translated and abstracted from L'Éclairage Électrique (Paris), February* 18.

General Instructions for Accepting Electrical Machinery.

The Syndicat Professionnel des Industries Électriques, Paris, has issued a set of instructions governing the acceptance of electrical machinery. These are here given in full, but can be referred to but briefly. The rating of the machine must be as follows: for direct-current dynamos, in kilowatts at the terminals of the generator; for alternating-current generators, in kilovolt-amperes at the terminals, the power-factor being imagined; for motors, in horse-power of seventy-five kilogrammemetres per second or poncelets of 100 kilogrammes per second. The power-factor must be mentioned. For heating, the following limits are established: for field circuits traversed by continuous current, forty-five degrees centigrade; windings of transformers, fifty-five degrees centigrade; all other electric circuits, except those always closed upon themselves, forty-five degrees centigrade; for electric circuits always enclosed within themselves, sixty degrees centigrade; for collectors and terminals insulated with mica and brushes, fifty-five degrees centigrade; for iron cores, sixty degrees centigrade; for bearings, terminals and connections, forty degrees centigrade. For machines, having collectors, which are intended to serve day and night, and for machines of more than 2,000 volts, except transformers, the temperatures are five degrees lower than the above. These temperatures suppose a temperature of the surrounding air of thirty-five degrees. The temperatures are to be measured by thermometers. For machines intended for intermittent service, the duration of the test is half that of a machine for continuous service. For the latter, the duration of the run is to be specified. With transformers for intermittent service, the test must be made after the transformer has been under load for a period equal to the time during which it would be called upon to operate. If the transformer is always connected to supply circuits, the time must be counted from the time when the transformer has reached its normal temperature at no load. For the transformers supporting a continuous load, the measurement must be made after the temperature has become constant. The following overloads must be supported: twenty per cent for one-tenth of the duration of the heating test; thirty per cent for five minutes. Traction motors must support an overload of twenty-five per cent for a quarter of an hour and fifty per cent for five minutes. These overloads must be carried after the machine has reached its working temperature. Continuous-current motors must support, for five minutes, a speed fifty per cent above normal. The coefficient of self-regulation of voltage or speed is defined by referring variations of voltage or speed to the voltage or speed under normal load. For generators and transformers, the regulation must be determined for both unity power-factor and a power-factor of 0.8. Rules for determining the efficiency are given, and the different losses defined. Insulation tests are made by applying an alternating potential to the windings and the core, having a value about sixty per cent greater than the normal voltage of the machine. The following are the allowable variations from the specifications: a variation of three degrees centigrade above the guaranteed heating is allowed. If the temperature rises not more than ten degrees, the machine will be accepted, but a reduction of one-half per cent of the price per degree above the three degrees allowed will be made. A variation in regulation of twenty per cent from the guarantee will be allowed. A variation of fifty per cent will be accepted, with a reduction of one-half per cent of the price for every ten per cent above the allowable twenty per cent variation. A variation of twenty per cent from the total or measurable losses is allowed. A variation of fifty per cent in these losses will be accepted, with a deduction of one per cent for every ten per cent above the allowable twenty per cent.—*Translated and abstracted from Le Revue Technique (Paris), February* 10.

Electrical Patents.

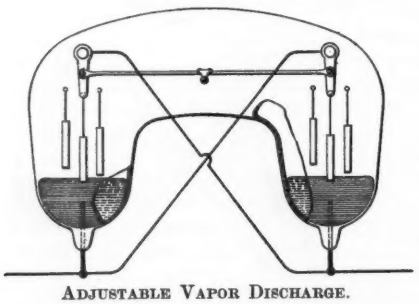
The Westinghouse Electric and Manufacturing Company is the assignee of a patent recently granted to Hermon L. Van Valkenburg, of Pittsburg, Pa., on a rheostat (782,887, February 21, 1905). The object of the invention is to provide a rheostat which shall be simple, compact and relatively inexpensive in construction,



RHEOSTAT.

and the resistance elements of which shall be so constructed and mounted as to be durable and thoroughly insulated and at the same time be so exposed to the air as to be effectively ventilated. A series of stationary contact terminals is provided and a movable arm adapted to make engagement therewith. A series of resistance elements is employed, each of which comprises a sheet-metal base fastened at one end to a corresponding stationary contact terminal. A non-conducting heat-resisting sheath has a coil of wire mounted thereon and connected at one end to the corresponding end of the sheet-metal base and at the other end to the next sheet-metal base in series.

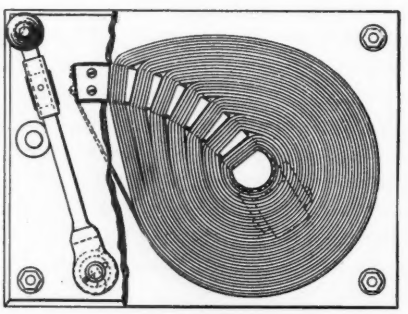
An adjustable vapor-discharge has been recently devised and patented by Percy H. Thomas, of Pittsburg, Pa., and



ADJUSTABLE VAPOR DISCHARGE.

assigned by him to Cooper Hewitt Electric Company, of New York (783,483, February 28, 1905). The qualities of the Cooper Hewitt gas or vapor electric apparatus which adapt it to serve the purposes of a spark-gap are already well known. It is known that apparatus of this character may be so constructed as to require a high voltage in order to break down the reluctance to starting which appears at the electrode, which for the time being is the negative electrode. Hitherto it has been customary to construct each apparatus for a definite breaking-down voltage and to adapt it in other respects, either to permit discharges in one direction only or in both directions. It is the object of the present invention to provide means whereby a discharge-vapor device of this general character may be constructed so as to be adjustable, that is to say, so that a given device may be adapted to discharge under different pressures. The invention comprises an enclosed conducting-gas or vapor and electrodes therefor. An electric circuit is connected to the electrodes and is adapted to impress upon the device a definite electromotive force. One or more starting-bands are provided and means for varying the effective relations of the starting band or bands and the negative electrode.

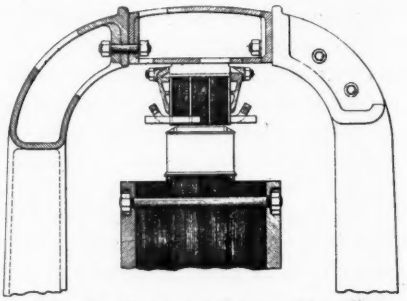
A patent on a rheostat recently granted to William H. Powell, of East Orange, N. J., has been assigned by him to Crocker-Wheeler Company, of Ampere, N. J. (783,979, February 28, 1905). The invention relates to the manner of arranging and combining the resistance-conductor and contact-blocks and the



RHEOSTAT.

manner of their support to form a substantial and compact rheostat of few parts and simple construction. The present form is designed for hand operation and for use as a starting rheostat for electric motors, as the construction is especially well adapted to this purpose, wherein a considerable mass is requisite to absorb the heat generated upon the operation of the rheostat; but special provision for the radiation and dispersion of the heat is of little importance, owing to the fact that a considerable interval of time elapses between successive operations The invention consists of rheostat terminals and a resistance element consisting of a coiled conducting-ribbon connected at the inner end of the coil to one of the terminals. A movable contact member is adapted to be moved above and parallel to the flat face of the spiral coil, and contact-blocks are disposed in the path of the movable contact member and contact with the different convolutions of the ribbon. Connections are provided through the movable contact member to the other terminal.

Bernard A. Behrend, of Norwood, Ohio, has assigned to the Bullock Electric Company, of Ohio, by direct and mesne assignments a patent recently granted to him on an improvement in frames for dynamo-electric machines (783,409, February 28, 1905). In the design of very large units it is not only necessary to consider the problems involved in the design of smaller machines,



FRAME FOR DYNAMO-ELECTRIC MACHINES.

but the design with reference to the shipping of the parts, their erecting and assembling, and proper support of the enormous weights must be specially considered; also as the diameter of large units is very great in comparison with their depth, any construction by which the diameter is reduced without correspondingly reducing the capacity is very advantageous. In the present invention the difficulties as to shipping and erecting have been overcome, and the advantage of a comparatively small diameter obtained. In the embodiment of the invention, the stationary frame is made up of two shields or end frames, provided with pedestals, which shields act as a support for the main frame, which is clamped between them. The shields and main frame may be subdivided into segments to a degree which the size of the machine requires. Since the shields or end frames support the main frame, the latter need not be designed as a supporting-yoke, but only of such strength as to take the weight of the laminations and windings carried thereby. For this reason the outside diameter of the machine is greatly reduced compared with what would be necessary if the main frame of the machine also served as a supporting-yoke.

The Cunard Twin-Screw Steamship Caronia.

THE Caronia is the latest addition to the fleet of the Cunard Line, and is the first of a quartette of large ships to be put into service in the near future by the Cunard Steamship Company, Limited. The vessel is 678 feet long, seventy-two feet six inches wide, and ninety-seven feet deep from keel to bridge. The draught loaded, is thirty-two feet, and the gross tonnage is 20,000 tons. There are twelve transverse bulkheads built in the vessel, all stiffened to resist any pressure that may be brought suddenly to bear upon them by flooding. The vessel has a cellular double bottom of very stiff construction. The ballast tanks have a combined water-carrying capacity of 3,450 tons. On each side of the vessel bilge keels are fitted, each eighteen inches deep, and extending a distance of about half the vessel's length amidships. The Caronia has eight continuous decks, namely: boat, promenade, bridge, shelter, upper, main, lower and orlop. The first six decks are for the use of passengers, and some of the third-class passengers are accommodated on the lower deck. There are accommodations for 300 first-class passengers and for 350 second-class. One thousand third-class passengers can be carried. The crew of the vessel comprises about 450 officers and men.

Steam is furnished the engines by thirteen Scotch boilers, eight of which are double-ended, and five single-ended. The boilers are fifteen feet ten inches in diameter. The single-ended boilers are twelve feet long, and the double-ended boilers are twenty-two feet long. Each single-ended boiler contains three furnaces, which are three feet ten inches in diameter. The double-ended boilers have three furnaces in each end, four feet in diameter. The depth of the furnace is eight feet in each case. The total heating surface of the boilers is 38,660 square feet in the double-ended boilers, and 16,110 square feet in the single-ended boilers. The total grate surface of all the boilers is 1,560 square feet. The boilers are operated at 215 pounds pressure per square inch. About 260 tons of coal are burned in each twenty-four hours. Forced draught is furnished the boilers by Howden's closed ash-pit system. Air is furnished by four fans 108 inches in diameter, each fan being driven by two direct-connected twelve by fourteen-inch engines running at 600 revolutions per minute. Ashes are removed from the fire-room by means of a Crompton atmospheric ash hoist with a capacity of about 24,000 pounds of ashes per hour.

Power to propel the vessel is furnished by two sets of quadruple-expansion engines of 21,000 aggregate horse-power, with cylinders thirty-nine, fifty-five, seventy-seven and 110 inches in diameter, respectively, by five feet six inches stroke. The engines are balanced upon the Yarrow-Schlik-Tweedy system, which reduces vibration to a minimum. At full speed they run at ninety revolutions per minute, giving the vessel a speed of about nineteen knots per hour. The crank shafts are twenty-two and one-half inches in diameter, and the propeller shafts twenty-three inches. The thrust of each propeller is taken by a thrust shaft which is twenty-two and one-half inches in diameter by fifteen feet ten inches long, and which carries thirteen thrust collars.

The engines exhaust into two main condensers. Each condenser contains 4,690 tubes, three-quarters of an inch in diameter and fifteen feet six inches long. The air-pump for the condenser is twenty-two by twenty-four inches, and is direct-connected to the main engines. In addition to the main condensers there is one auxiliary condenser for the auxiliary machinery. This condenser contains 2,960 tubes of the same size as those in the main condenser. Condensing water is furnished by two Allen centrifugal circulating pumps with forty-eight-inch discs. These pumps are driven at 100 revolutions per minute by two ten-inch by nine-inch engines, built by W. H. Allen & Sons, Bedford, England.

The condensed steam, leaving the condenser, passes through two Harris feed-water filters, and then through feed-water heaters which raise its temperature to 220 degrees Fahrenheit. It is passed to the boilers by means of four Weir feed-pumps. In order to supply fresh water to the boilers, there are installed two Weir and two Quigans evaporators with a combined capacity of eighty tons of fresh water per twenty-four hours.

The ship has two sets of Brown steering gear, one located below the water line, and the other on the shelter deck. This gear consists of a pair of engines mounted on the tiller. The engines drive a pinion which works in a section of an internal gear fixed on the vessel. The engines can be controlled from the bridge by means of a telemotor system, which operates the valves of the engines. In case the telemotor system becomes disabled, the engines can be operated by a steering wheel in either steering engine compartment, the orders being telegraphed from the bridge.

Electric current is furnished for lighting the ship and for operating various winches by four 100-volt, seventy-five-kilowatt Clarke-Chapman generators, running at 450 revolutions per minute, which are direct-connected to Belliss compound engines with cylinders nine and fifteen and one-half inches by seven inches. The engines are entirely enclosed and operate at 150 pounds per square inch steam pressure.

The switchboard is installed in the same room with the engines and generators, and consists of five panels, six feet by thirty inches. Two of these panels are feeder panels, and three are output panels. The feeder panels each carry two 1,000-ampere ammeters and one 120-volt voltmeter, two double-pole, single-throw knife switches, and two rheostats. Each feeder panel takes care of two generators. The three output panels each carry twelve single-pole, four-throw knife switches, which control the circuits running to various parts of the ship. The four-throw switches enable any circuit to be connected to any generator.

About 3,000 sixteen-candle-power lights are installed throughout the ship. In addition to these there is a powerful search-light upon the bridge.

On the boat deck are two electric winches for handling the small boats. These winches consist of a shaft extending the width of the vessel, with a drum on each end. In the centre of the shaft is a Clarke-Chapman twelve-horse-power motor running at 590 revolutions per minute. The motor is connected to the shaft by skew gearing. It can be controlled from either end of the shaft, a controller being placed on each side of the vessel. In addition to the electric winches there are sixteen steam winches installed in various parts of the ship for handling the cargo. These winches were built by John H. Wilson, of Liverpool, England.

The capstans are driven by two sets of eighty-horse-power engines, located in the forward part of the ship. These engines drive a countershaft through a set of bevel gears on the engine shaft and the capstan is driven from the countershaft by

means of a worm and wheel. The capstan engines were built by Napier Brothers, of Glasgow.

The refrigerating plant consists of three duplex double-acting compressors. The compressor cylinders are six by ten inches. The steam cylinders are fourteen by ten inches, and operate under 150 pounds steam pressure at 100 revolutions per minute. These three engines cool the rooms in which perishable portions of the cargo are carried. A fourth single engine of the same size as the duplex engine cools the provision room and the drinking water.

Fire protection is furnished by means of pipes arranged to blow steam into the hold, and by four direct-acting steam fire pumps. These pumps are nine by ten by twelve inches, and deliver water to 200 connections for fire hose in different parts of the ship.

The third-class quarters are ventilated by means of the Thermo-Tank Ventilating Company's system. Air is forced through coils, which may be heated if desired, by means of Sirocco fans directly driven by electric motors. Sirocco fans are also installed for ventilating the engine room. These fans are driven by five-horse-power motors.

The openings between the various water-tight compartments are closed by water-tight doors built on the Stone-Lloyd system. The doors are closed by hydraulic pressure from the bridge. At each door is a handle by which the door may be opened, in order to allow any one to escape from the compartment. The door will close, however, the instant this handle is released. The system is under 600 pounds pressure per square inch, and closes a door in about twenty-four seconds. A tell-tale system on the bridge shows the officer in charge just what doors are closed and which are open.

A telephone system is installed in the ship, connecting the wheel-house, the chief engineer, the captain's quarters and the tiller compartment.

The ship is in charge of Captain Robert Warr, and the chief engineer is Mr. John Currie.

The World's Production of Coal.

The world's coal production in 1903 reached the total of 864 million long tons, of which the United States supplied more than any other country. Statistics received by the Department of Commerce and Labor, through its Bureau of Statistics, indicate that the world's output of coal in 1903 was 864 million tons, of which the United States produced 319 million tons, as against 230 millions produced by Great Britain, 160 millions by Germany, thirty-nine millions by Austria-Hungary, and thirty-five millions by France.

The world's growth in coal production is coincident with its growth in commerce, indicating the close connection between coal supply and industry and transportation. From 1800 to 1850 the world's production of coal was relatively small, and only increased from eleven and one-half million tons at the beginning of that century to eighty-one millions in 1850; the world's commerce meantime increased from one and one-half billions of dollars to four billions. Since 1850 there has been a marked increase in the production of coal, and an equally notable expansion of international commerce. Coal production has, in the last half century, increased tenfold, and commerce more than fourfold, the former increasing from eighty-one million tons in 1850 to 864 million tons in 1903; the latter from four billion dollars in 1850 to twenty-two billions in 1903.

The rapid growth in the world's production of coal is even surpassed by the record of the United States. In 1800, when anthracite coal was practically unknown in the United States, the world was producing over eleven million tons of coal per annum. In 1870, when the world's coal production amounted to 213 million tons, the United States supplied but thirty-three millions, or about fifteen per cent of the whole, being exceeded by Great Britain with 110 million tons, and Germany with over thirty-three millions. From 1870 to 1903 the growth in the world's coal production has been from 213 millions at the first named year to 864 millions in 1903, a gain of 651 million tons, or over 300 per cent. For the United Kingdom the growth has been from 110 million tons in 1870 to 230 million tons in 1903, a gain of 120 million tons, or 110 per cent; for Germany, from thirty-three million tons in 1870 to 160 millions in 1903, an increase of 127 million tons, or 385 per cent; and the United States from thirty-three millions in 1870 to 319 millions in 1903, an increase of 286 million tons, or 867 per cent, and forming in that year thirty-six and one-half per cent of the world's coal supply, as against fifteen per cent in 1870.

The United States, the United Kingdom, and Germany supplied four-fifths of the world's coal product, the share contributed by these countries being: United States, thirty-seven per cent; United Kingdom, twenty-seven per cent; and Germany, eighteen and one-half per cent. These countries also lead in the production of domestic manufactures, and in like rank in the exportation of domestic products. For 1903, exports of domestic products from the countries named were, Germany, 1.20 billions of dollars; United Kingdom, 1.42 billions; and the United States, 1.44 billions.

The following table shows the world's production of coal and the share supplied by the United States, at quinquennial periods, from 1870 to 1900, and annually from 1900 to 1903:

Year.	World's Production Million Tons.	Produced by United States.	
		Total. Million Tons.	Per Cent.
1870.....	213.1	32.9	15.4
1875.....	275.4	46.7	17.0
1880.....	330.3	68.0	20.6
1885.....	399.8	99.2	24.8
1890.....	503.3	140.9	28.0
1895.....	575.1	172.4	30.0
1900.....	755.4	240.8	31.9
1901.....	777.4	261.9	33.7
1902.....	788.9	269.3	33.9
1903.....	864.1	319.1	36.9

Of this output of 319 million tons by the United States, practically the entire amount is consumed in the domestic market, as the exports of coal have averaged but about five and one-half million tons per annum during the last five years, and have never exceeded more than three per cent of the total product of a single year. Imports of coal into the United States are also small, and in the last calendar year amounted to but about one and one-half million tons, as against three and one-third millions in 1903, having averaged about one and one-half millions per annum in the decade from 1894 to 1903. The United Kingdom, however, is the world's greatest exporter of coal, her annual exports having ranged between thirty-five and forty million tons, out of a total product of from 200 to 230 million tons during the last five years.

Financial Statement of the United States Telephone Company.

The financial statement of the United States Telephone Company for the year 1904 shows total assets of $4,952,833.63. This compares with $4,685,048.22 in 1903. There is a surplus of $56,125.88. The gross earnings for 1904 were $418,308.07, as against $379,235.10 in 1903. The total expenses and taxes were $266,139.83, making the net earnings, $152,168.24. After making deductions for various charges, rentals and interest, there is a balance surplus of $40,905.62 for the period.

The Osmium Lamp.

The following is an abridged translation of a paper on the osmium lamp read by Herr Fritz Blau before the Elektrotechnischer Verein, of Berlin, on January 24:

The total energy radiated by a heated body is proportional to the fourth power of the absolute temperature of the body. As the temperature increases, the percentage of the short waves emitted, as compared with those of long length radiated, increases also very rapidly; but the absolute value of this percentage varies for different bodies, being smallest in so-called "black" bodies, but comparatively high in bodies with a metallic lustre and smooth surface. Only these short waves, it need hardly be said, are observed as light. An efficient light-giving body must, therefore, withstand very high temperatures; its radiating surface, at a given efficiency, should be as large as possible; the substance of the filament should be transparent or white to minimize the effects of blackening; the surface of the filament should not become blacker or rough with use, and its resistance should increase with increasing temperature.

Osmium, generally in the form of osmium-iridium, is found in platinum ores and also in gold sand with gold and silver. It is at present usually obtained by alloying the residue which remains when platinum is dissolved in aqua regia, with metals, such as zinc, lead or tin. The osmium-iridium passes thereby into a finely divided state, and if it is now heated in a current of oxygen it will split up into osmium tetroxide and iridium. Osmium may then be obtained by treating the osmium tetroxide with any reducing agent.

When Herr Auer von Welsbach invented the osmium lamp some six years ago, he found it impossible to draw osmium in form of wire, and he first tried the expedient of coating platinum wire with osmium and evaporating subsequently the greater part of the platinum. It was observed, however, that a platinum-osmium alloy was formed which—when containing more than four per cent of platinum—began to melt when the platinum was being evaporated. In order to keep the percentage of platinum below this figure, the finished filament had to be made about five times thicker than its platinum core. As uniform platinum wire was not obtainable in thickness less than 0.02 millimetre, it will readily be seen that the osmium filaments could not advantageously be made in diameters below 0.1 millimetre. Such filaments, however, are not suitable for lamps consuming less than one ampere.

The next and final step was to mix most finely divided osmium with certain organic binding substances to a thick tenacious paste. The paste is forced under high pressure through a diamond or sapphire die on to a card which is moved about in such a manner that the filament is deposited in loops. After drying, the organic binding substance is carbonized by heating the filament in vacuo. This

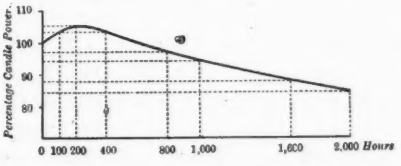


FIG. 1.—PERCENTAGE VARIATION IN CANDLE-POWER OF 37–44-VOLT AND 25–32 (HEFNER) CANDLE-POWER OSMIUM LAMP.

porous filament, rich in carbon, is then gradually heated to an intense incandescence by an electric current in an atmosphere containing much steam and a certain quality of reducing gases. The carbon of the raw filament changes into carbon oxide and carbon dioxide, and after a relatively short time the filament consists of pure, or very nearly pure, osmium only, the percentage of carbon being insignificant. Although the density of the filament has greatly increased during this process, the filament is still porous and its surface is far from smooth. After trying unsuccessfully several means of connecting the filament to the platinum leads, it was found that a very satisfactory method was to fuse them together by

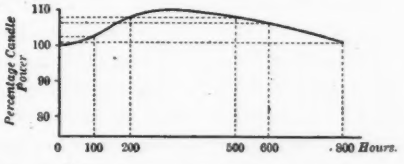


FIG. 2.—PERCENTAGE VARIATION IN CANDLE-POWER OF 110-VOLT, 32 (HEFNER) CANDLE-POWER OSMIUM LAMP.

the electric arc. Osmium is brittle when cold, but soft when heated, and for this reason the lamps as made at present are required to burn in a definite position.

When the manufacture of this lamp was taken up by the Deutsche Gasglühlicht Actiengesellschaft, the highest voltage that the lamp could stand was twenty-seven volts. After the lamps had been perfected to burn at thirty-seven volts, they were put on the open market. The lamp voltage was soon after brought up to forty-four volts, and during the last few months a considerable number of fifty-five and seventy-three-volt lamps have been sold. Quite recently 110-volt lamps have appeared.

The filament of an osmium lamp for thirty-seven volts, twenty-five candle-power (Hefner units) consuming one and one-half watts per candle-power, has a diameter of 0.087 millimetre and a length of 280 millimetres. The radiating surface is from three square millimetres to 3.2 square millimetres per candle-power. If an ordinary glow lamp be run at one and one-half watts per candle-power, its radiating surface per candle-power is only 1.6 square millimetres. The carbon filament, therefore, must be both hotter and "blacker" than the osmium filament. With an increase of voltage of ten per cent the current increases 6.5 per cent in the case of the osmium lamp, and twelve per cent in the case of the carbon filament lamp The corresponding increase in illuminating power is forty per cent and eighty per cent, respectively.

It is not possible to state definitely the life of an osmium lamp, but 5,000 hours have been repeatedly exceeded. Figs. 1 and 2 represent the relationship of illuminating power to time—for a thirty-seven-volt lamp, and 110-volt lamp, respectively. Blackening of the bulb is very rare (observed in ten per cent only of the lamps investigated so far).

The surface of the lamp filament is at first somewhat rough, but it gradually becomes smoother, and this is the reason why the candle-power increases during the first 250 hours or so. Before the lamp is ready for sale, it is burned in the factory for several hours in order to bring the lamp up to an approximately steady state.

If the lamp is run at less than one and one-half watts per candle-power, the structural changes in the filament occur too rapidly for practical purposes. Nevertheless, lamps consuming one watt per candle-power only have been observed to burn for several hundreds of hours without decrease in light. When exposed to hard shocks, the osmium lamp filament is somewhat more liable to break than the carbon filament, but if properly packed the loss through breakages in transit is small, being only about one and one-half per cent. These lamps stand the shocks of railway carriages and omnibuses very well. The osmium lamp is efficient also for very low voltages and a large number of two-volt lamps for mines are in use in connection with portable accumulators. For a long time it was not possible to make thin filaments, but recently it has become feasible to reduce the diameter down to 0.03 millimetre.—*Electrician (London), March* 3.

Special Report on Street and Electric Railways.

The Bureau of the Census has published an exhaustive report on street and electric railways for the year ending June 30, 1902, prepared under the supervision of Mr. W. M. Steuart, chief statistician for manufactures.

In June, 1903, a preliminary report on this subject was issued in the form of a Census bulletin giving the principal statistics for all street and electric railways doing a public business in the United States.

The report just published contains, in addition to detailed statistics, more than two hundred pages of text prepared by two expert special agents, Mr. T. Commerford Martin, of New York city, and Mr. E. Dana Durand, of the Bureau of Corporations. This text discusses the development of the modern street railway system, the generation and distribution of electric current, car equipment, and a variety of other features upon which the technical efficiency and economy of the street railway service depend. It also treats of methods of installing and operating interurban systems, handling passengers, freight, mail express, etc. Statistics are presented showing the growth of mileage and traffic, and the effect of development upon the distribution of the population.

During the twelve years from 1890 to 1902 the total single track mileage for street and electric railways increased from 8,123 to 22,577. This increase was due partly to the establishment of new railways, but principally to the extension of the lines already existing.

The mileage of the electric lines increased from 1,262 to 21,907, while there was a decrease for the lines operated by other motive power, the decrease being from 488 to 241 miles for cable lines, from 711 to 170 miles for steam lines, and from 5,662 to 259 miles for lines using animals for their motive power.

In proportion to its area, Massachusetts has much more electric railway mileage than any other state.

The average length of track per operating company increased from 10.56 miles to 27.63 miles during the same period.

The increase in mileage was accompanied by corresponding increases as follows: cost of construction and equipment, from $389,357,289 to $2,167,634,077, or 456.7 per cent; operating expenditures, from $62,011,185 to $142,312,597, or 129.5 per cent; number of passenger cars, from 32,505 to 60,290, or 85.5 per cent; number of fare passengers carried, from 2,023,010,202 to 4,774,211,904, or 136 per cent; and number of employés, from 70,764 to 140,769, or 98.9 per cent.

There were 66,784 cars of all classes in the United States in 1902. Of this number, 60,290 were passenger cars and 6,494 were cars used for express and other purposes. Of the passenger cars, 32,658 were closed, 24,259 were open, and 3,134 were combination closed and open cars, while 239 were combination passenger and express cars. There were 1,114 cars devoted solely to express, freight, and mail business.

An interesting development in electric railway service is the construction and equipment of sleeping cars for use on long-distance lines in Ohio and Indiana.

The largest number of cars of all classes for any state was reported for New York, the number being 14,040.

About half of all the cars in the United States were equipped with heating apparatus, 19,021 being heated by electricity and 11,138 by stoves, hot water, or other contrivances. Many railways, however, have two sets of cars—one for use in summer, and the other in winter—so that in winter the proportion of the cars in operation equipped with heating apparatus is larger than these statistics would at first glance indicate.

The report shows also that 62,369 cars, or 93.4 per cent of the total number, were lighted. Of these 55,703 were furnished with electric lights.

The total number of passengers carried was 5,836,615,296, of which 1,062,403,392, or 18.2 per cent, were transfer passengers.

The average number of rides per inhabitant advanced from thirty-two in 1890 to sixty-three in 1902 for the country as a whole, while the advance for the urban population was from 98 to 168. The proportion of rides to the total population is greatest in the District of Columbia, where the whole population is urban, and is next greatest in Massachusetts, while New York ranks third. California has the highest proportion of rides to the urban population, largely as a result of the hilly streets in San Francisco, which compel general resort to this method of travel.

Five cents is the almost universal rate of fare for the urban lines in the United States, although more than one-third of the companies offer lower rates under certain conditions. Frequently six tickets are sold for twenty-five cents, but occasionally a larger number is required to be purchased in order to secure a low rate. Some companies give reduced fares to workingmen during certain hours of the day and to children going to and from school, while a few other companies carry children between certain ages at a reduced rate.

Considerable competition has arisen between the steam roads and the electric interurban lines. While the steam roads have the advantage of greater speed, the frequent service, convenient stops, and low fares of the electric roads have, in many instances, seriously affected the local traffic of steam railways. Statistics show that in 1902 the street and electric lines of the United States carried more than seven times as many fare passengers as the steam railways. Such a comparison, however, means little, since steam railway journeys are, as a rule, much longer than those on street railways. In 1902 the average distance traveled by passengers on the steam roads was 30.3 miles. No definite average can be given for the distance traveled by passengers on the street lines, since no records have been kept by the street railway companies relative to this point. The receipts from passengers were $392,963,248 for steam railways, and $233,821,548 for street railways.

In 1902 the passenger earnings of the street railways were 94.5 per cent of the total receipts; the remainder of the revenue was derived from the sale of electric current, from freight, mail, and express service, and from advertising and other miscellaneous sources.

The average number of salaried officials and clerks employed by the street railway companies of the United States in 1902 was 7,128 and the average number of wage-earners was 133,641. The salaries paid amounted to $7,439,716, and the wages to $80,770,449. The wages alone formed 56.8 per cent of the total operating expenses of the street railway companies.

By far the most important groups of employés are conductors and motormen. These two classes, which are approximately equal in number and in wages received, constituted about three-fifths of the total number of wage-earners. The most common rate of pay was two dollars per day.

The highest wages were reported in Montana and the lowest in Alabama, Arkansas, Georgia, North Carolina, and Tennessee.

The accident statistics show that during the year 1,218 persons were killed and 47,429 were injured by street railway

lines. Of the total number killed 265 were passengers, 122 were employés, and 831 were persons on foot or riding in vehicles other than street cars; of the injured 26,690 were passengers, 3,699 were employés, and 17,040 were other persons. These numbers form only an inappreciable percentage of the total number of passengers carried. One passenger was killed for every 18,015,894 fare passengers carried, and one was injured for every 178,876 passengers. The rate of accident for the wage-earners was one killed out of 1,095 and one injured out of thirty-six. This rate is very much lower than the rate for steam railroads, for which one employé out of every 401 was killed and one out of every twenty-four was injured.

The reform in the direction of safety provisions for steam railway crossings has of late years been quite considerable in all large American cities, and has been carried on at an enormous expense, so that, of the steam railway crossings now unprotected, a large proportion are to be found in rural districts. The report states that in 1902 there were 4,481 crossings, of which more than half were protected; 1,967, however, were still without any form of protection, not even being supplied with bells or watchmen.

One of the most important factors in street railway progress has been the combination of formerly independent railways into great systems. Fifteen or twenty years ago most of our large cities were served by several separate animal power railways and there was usually no competition between these independent companies in the matter of fares. The introduction of mechanical traction, especially electric traction, developed a much stronger tendency toward consolidation than existed before. In most cases the establishment of a unified system made it possible to carry passengers more nearly where they wanted to go and to carry them longer distances; this augmented the traffic of the railways to such an extent that it proved decidedly profitable to the companies.

Legislation permitting municipalities to own and operate street railways has recently been enacted in a number of states. There is, however, no instance in the United States of municipal operation of a street railway. The leading instances of municipal ownership and private operation are the subways in Boston and New York.

This report gives some interesting illustrations of the extent to which the outer areas of cities have increased through the development of the street railway. For instance, the population in Manhattan borough of New York city increased from 1,441,216 in 1890 to 1,850,093 in 1900, or 408,877. Of this increase, 231,556, or considerably more than one-half, took place in that part of the island lying north of Eighty-sixth street, the population in this section having practically doubled during the decade. This district is situated about seven miles from the southern extremity of the city, and the great majority of its breadwinners do business downtown and make daily use of the street railways.

In Bronx borough the population increased from 88,908 to 200,507, the increase being mainly along the street and elevated railway lines. In Brooklyn and Queens boroughs the increase in population was thirty-nine and seventy-six per cent, respectively, and in each case the advance was mainly in the outlying wards.

Another conspicuous illustration of this influence is furnished by the city of Boston. Of the seven wards lying nearest to the business centre of Boston, five showed a decrease in population, while in the outlying wards there was an increase of 93,395 inhabitants, or nearly five-sixths of the total increase of Boston. Moreover, the population of the immediately adjacent cities of Cambridge, Somerville, Chelsea, and Brookline increased much more rapidly than that of the older parts of Boston. A very considerable proportion of the breadwinners, both of the outlying wards and of the adjacent cities, are employed in the business district of Boston and depend upon the electric railways for their transportation.

The change in the distribution of the population of Philadelphia since 1890 has been remarkable. Almost all of the wards in the heart of the city show a decrease in population, while several of the large outlying wards to the west and north of the business centre have added greatly to the number of their inhabitants.

Chicago, Cleveland, and other cities show this influence of railways in scattering population.

Even in medium-sized cities the street railways encourage the distribution of population and thus reduce the evils of overcrowding and unsanitary surroundings.

Moreover, the electric railway has given a powerful impetus to suburban life, not only for residence but also for manufacturing purposes. The effect of this influence is shown in the increased population of the suburbs of Boston and Philadelphia, two cities whose suburban residents are served largely by electric railways. Other cities showing this influence in a marked degree are St. Louis, Milwaukee and Cleveland.

The Ninth Annual Meeting of the Iowa Telephone Association.

The ninth annual meeting of the Iowa Telephone Association was held at the Hotel Chamberlain, Des Moines, Iowa, March 14, 15 and 16. The following programme was presented:

Tuesday, March 14, two P. M.—Organization. Appointment of committee on credentials. President's address, J. C. Sullivan, Creston. Address by W. H. Barth, of the Sheldon School of Scientific Salesmanship, on "The Science of Modern Business Building."

Wednesday, March 15, nine A. M.—C. H. Judson, Council Bluffs, "The Old Way and the New." Oscar Knell, Perry, "A Generator Call, Lamp Line Board." Charles E. Wells, Marion, Kan., "The Kansas Supreme Court Decision."

Wednesday, March 15, two P. M.—N. T. Guernsey, Des Moines, "The Iowa Assessment Law." J. M. Plaister, Fort Dodge, and R. D. Redman, "Magneto Multiple Versus Central Energy Multiple Boards for Small or Moderate-Sized Exchanges." C. A. Hollis, Hudson, "The Relations That Should Exist between Farmers' Mutual and Other Independent Telephone Companies."

Thursday, March 16, nine A. M.—J. E. Shoemaker, Waterloo, "The Development of the Toll Business, and the Checking of Tolls." James B. Hoge, Cleveland, Ohio, "The National-Interstate Telephone Association." New business and election of officers.

On Thursday afternoon a visit was made to the new exchange of the Mutual Telephone Company, and on Thursday evening the annual banquet was held.

F. F. Proctor is ever in the front in the way of providing timely attractions to his patrons. On the evening of March 4, inauguration day, there were presented at all of the Proctor houses in New York views of President Roosevelt and the inauguration, taken in Washington earlier in the day. A special corps of trained men were assigned to handle the photographs, their development into lantern slides, and their delivery at the respective houses. These snap-shot views are decidedly popular.

Oil for Insulating Purposes.

Under the title, "Oil for Insulating Purposes," the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa., has published a special pamphlet written by C. E. Skinner, which contains a great deal of practical information. Only one phase of the wide range of service for which the oil may be used as an insulating medium is taken up—that of its use for transformer and oil-switch work. The following paragraphs have been abstracted, as being of especial interest to our readers:

All oils—mineral, vegetable and animal—when pure, are good insulators. There is a wide difference in the insulating qualities of various mineral oils, but this difference seems to be more an index of the purity of the oil than an inherent difference due to variations in the chemical composition of the oil itself. By purity is meant freedom from acid, alkali, water or foreign matter of any kind. The method usually employed in determining the insulating value of an oil is to test its dielectric strength. Satisfactory insulation resistance measurements are difficult to make, and while showing something of the quality of the oil, are not of as much value as dielectric tests. As the actual values of the dielectric strength obtained vary greatly with the testing conditions, it is best to use a standard method and always follow this out carefully. Satisfactory comparative values may then be obtained and the general insulating values determined with sufficient exactness for all practical purposes.

The usual method of testing consists of immersing a spark-gap in the oil, the gap being set at a known distance, and gradually raising the potential until rupture occurs. In making such tests the following points should be observed:

The spark-gap terminals should always be of the same shape and nicely polished, especially if the gap is quite small. Slight roughness or points on the testing terminals will change the apparent dielectric strength of the oil.

The gap should always be at the same depth in the oil. A variation in depth, consequently a variation of the pressure, will cause a variation in the tests. The apparent insulating strength increases with the pressure.

The testing voltage should always be applied in the same manner. It is preferable to fix the gap and apply an increasing voltage until breakdown occurs; or a constant voltage may be applied and the gap gradually shortened until the distance becomes such that rupture occurs. In the former method the voltage may be very gradually increased as may be done by controlling the field of the generator, or it may be applied in steps either with or without opening the circuit between steps; but for comparative purposes one method only should be used.

The time of application of the voltage should be as nearly as possible the same, especially the time consumed after the voltage reaches, say, fifty per cent of the dielectric strength. A longer time will give lower results, especially if the oil contains impurities which may "line up" between the testing terminals.

It is a good plan to make more than one test on each sample of oil, as the test value frequently increases with the first few tests, especially if the oil is well shaken after each test so as to thoroughly mix with the oil the carbon formed by the arc and not allow it to concentrate between the testing terminals. When so shaken it must be allowed to stand until free from air bubbles before another test is made. This increase in dielectric strength seems to be due to the drying effect or to the burning out of impurities in the oil. The best oils do not usually show much increase with repeated tests. When the oil becomes very black and dirty from repeated tests the dielectric strength drops rapidly.

The amount of oil used for each test should be the same in every case, especially if more than one break is made in each sample. It is obvious that the carbon formed by the burning of the oil will be disseminated through the oil, and that the results will depend in some measure upon the amount per cubic inch of oil. It follows from the above that if more than one test is to be made on a given sample, the amount of energy expended by the arc formed due to the rupture of the oil should be the same as nearly as possible for each break. It is best to limit this to a comparatively small amount by a fuse or circuit-breaker in the primary of the testing transformer, arranged to open the circuit on a comparatively small current. By using small currents the work of keeping the terminals clean is much facilitated.

The frequency and the electromotive-force wave form of the testing circuit should be kept the same in the successive tests. It was pointed out some years ago by Professor Elihu Thomson that oil is not as good an insulator for low as for high frequencies. There is, however, little variation for commercial frequencies. It is well known that a pointed or saw-tooth electromotive-force wave will break down insulation of all kinds more readily than a flat, smooth wave of the same square root of mean square electromotive force. The use of a resistance for varying the testing voltage is therefore very objectionable.

All vessels and apparatus used must be kept perfectly clean. A single fibre in the oil may reduce the dielectric strength greatly if it happens to "line up" between the terminals. A small amount of moisture, as will be shown later, is particularly objectionable on account of the very great reduction which it may make in the insulating value of the oil.

It is best to allow the oil to stand a short time after pouring into the testing vessel, as the bubbles of air which are carried with the oil in pouring in, or due to the oil being agitated, will lower the apparent dielectric strength.

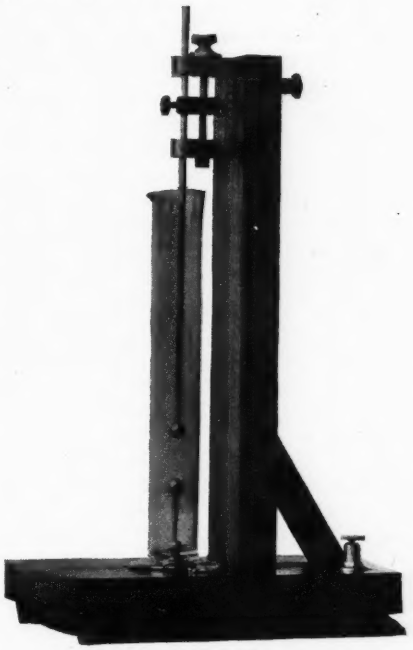
As a convenient method of testing, the author has devised a testing cup which is shown in the accompanying illustration. This consists of a 200-cubic-centimetre graduated glass cylinder one and three-eighths inches inside diameter, with a hole drilled through the bottom through which the lower terminal is inserted. The testing terminals consist of one-half inch diameter brass balls fastened to three-sixteenths-inch rods. The upper rod passes through a clamp which is connected to a micrometer screw actuated by a milled head. The lower terminal should fit in a socket so that it may be readily removed for cleaning. The bottom of the cup is made oil-tight by the use of gaskets where the lower rod passes through the cup. An extension of the lower rod comes in contact with a spring set in the base of the stand to which the line terminal is connected by means of a convenient binding-post. Stops are provided so that the oil vessel may always be placed in the same position. The upper rod may slide up and down easily when the clamping screw is free, or may be engaged with the micrometer screw at any point for adjusting the gap. All parts are therefore readily accessible for cleaning, and the zero point of the gap may be quickly adjusted for each test by allowing the upper rod to slide down so that the terminals are in contact and then clamping to the micrometer screw. The apparatus is always filled to the 200-cubic-centimetre mark (requiring a little less than 200 cubic centimetres of oil for each test). The gap is adjusted to

any convenient amount, usually 0.15 of an inch, and the electromotive force is raised gradually until the breakdown occurs. After trying numerous forms of testing apparatus for this purpose this method has been adopted as the most convenient, and it has the advantage of requiring a comparatively small amount of oil for each test.

Mineral oils begin to evaporate slightly at a temperature somewhat below their flashing point and the evaporation is quite rapid at the flashing point and above. It is therefore essential that a transformer oil have a flash test sufficiently high so that evaporation will not take place at the ordinary running temperature of the transformer. The evaporation test, if made at a temperature approximately 100 degrees centigrade, will also drive off any moisture which may be present in the oil. In the case of high flash test oils the evaporation test at 100 degrees centigrade may therefore show approximately the amount of moisture present in the oil. The evaporation test is not so necessary as the insulation and flash tests, but such test should be made occasionally on oil which is used for transformer work. A convenient method of making this test is to place a small amount of oil—usually approximately two grammes—in a small porcelain crucible and heat this over a water bath at a temperature of approximately 100 degrees centigrade for ten or twelve hours, then determine the percentage evaporation by loss in weight.

Moisture—The deteriorating effect of moisture on the insulating quality of an oil is very marked. As there are a great many ways in which the oil may take up moisture or moisture may be introduced into the oil, tests for moisture become very important. A very easy and satisfactory method of making test for moisture has been suggested to the author by a prominent oil chemist. The test consists in placing a small amount of oil in a cup, into which is plunged a piece of iron or other metal which is heated to a temperature just below a dull red heat. Any hissing or crackling noise indicates the presence of moisture. Another method of testing for moisture is to place a small amount of anhydrous copper sulphate in a test tube and then fill the tube with the oil to be tested. After thoroughly shaking, a bluish tinge in the copper sulphate will indicate the presence of moisture in the oil.

It is difficult to determine the exact amount of moisture in oil when the amount is small, and this is usually not necessary as it is sufficient to know qualitatively whether or not moisture is present. In making test for the effect of different percentages of moistures in the oil it was found necessary to thoroughly dry the oil, then introduce moisture in the form of water in minute quantities in a closed vessel and very thoroughly agitate the oil so as to disseminate the water through it. Moisture introduced into the oil to the amount of 0.06 per cent reduced the dielectric strength of the oil to about fifty per cent of the original value when it was known to be free from moisture, and that there was very little further decrease in the dielectric strength due to increasing the amount of moisture introduced in the form of water.



Oil-Testing Cup.

In many transformers waterproofing compounds are used which may or may not be soluble in the oil in which the transformer is immersed. These waterproofing compounds are necessarily good insulators. The materials used may have either an asphalt, coal tar or linseed oil base. When asphalt or coal tar base compounds are used they are always somewhat soluble in oil, especially when the oil is hot. Compounds having a linseed oil base, when thoroughly dry, are practically insoluble in mineral oil. When large quantities of waterproofing material, with asphalt or coal tar as a base, are used in transformers, the compound resulting from the combination of the waterproofing material and the transformer oil may form a pasty mass, which will close up the ventilating spaces and consequently cause dangerous heating of the transformer due to lack of ventilation. From an insulation standpoint there is no objection to the waterproofing compound being dissolved out after the transformer is put in service, provided the design is such that the ventilating spaces which are essential to the cooling of the transformer are not filled up. Any compound which is soluble in mineral oil should not be depended upon for cementing parts of the transformer or for closing spaces when this compound may be dissolved out by the oil later. The linseed oil compounds are waterproof in the sense that they will not allow water to pass through where there is an unbroken film; but they are not waterproof in the same way that asphalt and coal tar base compounds are waterproof, *i e.*, they are not "water-repellant." When transformers are treated with linseed oil compounds more care must be taken to prevent the absorption of moisture than when the other class of compounds is used. It is to be hoped that the varnish chemists will be able to give us a compound which has all the waterproofing qualities of the asphalt and coal tar bases, but which will be entirely insoluble in mineral oil.

The requirements of oil for oil switch work are very similar to those of oil for transformers. As stated before, oil having a very low "cold test" may be desirable for use in switches which are intended for outdoor work; but as this use is comparatively small at the present time this point need not receive consideration in connection with the general application of oil to oil switch work.

It has been stated above that the more fluid the oil for transformer work the more rapid will be the cooling of the transformer on account of the more rapid circulation of the oil in the transformer tank. In switch work a more viscous oil seems to give better results, possibly on account of the fact that it is not so easily displaced by the arc as by the lighter oil. Otherwise the requirements throughout may be stated as being exactly the same for both transformer and switch work, and it has been found possible to manufacture an oil which is entirely suitable for both purposes.

It sometimes happens that through faulty bushings or lack of proper precautions in closing up the case when the transformer is installed, water will find its way into the case. This always settles to the bottom of the case and when in sufficient quantities will rise so as to reach the coils, causing a burn-out. In

high-tension transformers the presence of water in the oil is dangerous and may cause burn-outs even though the water does not reach the transformer windings. If water is suspected it may be readily found by inserting a thin glass tube down the side of the transformer to the bottom of the case, the upper end of the tube being stopped with the finger until the tube strikes the bottom. The finger is then removed and the oil allowed to enter the lower end of the tube. The upper end is then closed and the water from the bottom, if any be present, may be drawn out. The contents of the tube should then be discharged into a tall bottle or test tube, and if water is present in any quantity it should at once be apparent to the eye. The remedy in this case is to remove the oil from the transformer and substitute oil which is known to be free from water.

Oil which contains water is not injured for use provided the water is removed. This may be done by allowing the water to settle to the bottom, drawing off all this water and then drying out the moisture contained in the oil by heating it to a temperature of 100 degrees to 110 degrees centigrade until the hot iron test shows no moisture present. A more delicate test for moisture is made by breaking down the oil with high potential. Dry oil should stand a test of 20,000 volts or more and oil is frequently found which will stand 25,000 to 33,000 volts under these conditions (striking distance 0.15 inch).

Protective Apparatus.

The March issue of the *Electric Club Journal* contains an interesting article entitled "Protective Apparatus," by N. J. Neall. This details a method of investigating lightning arrester operation. In the summer of 1902 the Utah Light and Power Company offered Mr. Percy H. Thomas, of the Westinghouse Electric and Manufacturing Company, an idle branch of its transmission line for experimentation with lightning and static disturbances. This branch, known as the Sandy line, is some six miles in length, and situated south of Salt Lake City in a valley lying north and south, and bounded on both sides by mountains rising 2,000 feet or more. The particular value of this portion of the country for the investigation of lightning arrester operation lies in the fact that charged clouds and storms, passing east and west over these mountains, exhibit a pronounced tendency to discharge, thus affecting many transmission lines below. This idle line was disconnected from the main lines and absolutely without voltage. The experimental work was limited to the placing of spark-gaps between the line and the ground, and the interception of a standard choke coil in parallel with the spark-gap. The gaps were given various openings, and tell-tale papers were inserted to note discharges.

About September 1 a heavy storm occurred, and a very complete record of the discharges was obtained. In investigating the tell-tale papers after the storm, the papers are usually held to the light, some of the punctures being so fine as to be almost invisible. These tell-tale papers were greatly magnified and photographed so that an opportunity was afforded for a study of the detail of the punctures.

The punctures showed an almost total absence of charring around the end of the puncture. Some of the smaller holes were absolutely without current trace, the larger holes showing a very slight browning. The important information conveyed by this phenomenon was the substantiation of the theory of induced atmospheric charges, the exceedingly high-potential thereby imposed on the lines, and the value of the gaps to earth to relieve this strain.

The real test of a lightning arrester must be made in service. The materials necessary are light-weight bond papers of uniform texture, which should be inserted in the gaps to be investigated, and so shaped as to make it impossible for a discharge to pass without puncturing them. Each arrester on the system should have several of these papers, carefully dated, marked with the location on the line, and of sufficient size for any remarks as to the particular events registered thereon by a static discharge.

Electricity for Rio.

Announcement has been made of the formation of the Rio de Janeiro Tramway, Light and Power Company with a capital of $25,000,000 and a bond issue of a like amount. The company is organized for the purpose of developing a great water-power plant near Rio de Janeiro, and it is planned from a plant already in process of construction to transmit electric power to the city for street railway, industrial and lighting purposes.

A number of New Yorkers, including William L. Bull, of Edward Sweet & Company, Dr. F. S. Pearson, and Percival Farquhar, are interested in the formation of the new company, together with Sir William Van Horne, of Montreal, and William MacKenzie and E. R. Wood, of Toronto. The bonds are all underwritten, the Canadian Bank of Commerce, the Bank of Montreal, the National Trust Company, of Toronto, and the Guaranty Trust, of New York, being interested in the underwriting. The company has a concession which gives it the exclusive right to transmit to Rio de Janeiro electricity developed from water power.

A Change in the United Telpherage Company.

The Dodge Coal Storage Company has forwarded to this office the following notice:

After this date, the business of the United Telpherage Company will be conducted by the Dodge Coal Storage Company, as a coalescence of interests has been effected.

Therefore, all communications relative to the business of the United Telpherage Company should be addressed to the

United Telpherage Department,
DODGE COAL STORAGE COMPANY,
No. 49 Dey Street, New York,
where they will receive prompt attention.

Very truly yours,
THE DODGE COAL STORAGE COMPANY,
New York, March 2, 1905.

The United Telpherage Company, under the active and far-seeing management of Mr. H. McL. Harding, attained a commanding position in the electrical field for supplying and installing electrical conveying apparatus. The coalescing of the United Telpherage Company with the Dodge Coal Storage Company can not fail to be of mutual advantage and strength.

Meeting of the American Institute of Electrical Engineers.

The 195th meeting of the American Institute of Electrical Engineers will be held at the chapter room, Carnegie Hall, No. 154 West Fifty-seventh street, New York, on Friday, March 24, 1905, at 8.15 P. M.

The following papers will be presented and discussed:

1. "Line Construction for High-Pressure Electric Railroads," by George A. Damon.
2. "High-Pressure Line Construction for Alternating-Current Railways," by Theodore Varney.
3. "Application of High Pressure to Electric Railroads," by Ernest Gonzenbach.

The Michigan Central (the Niagara Falls route) is distributing an attractive and practical calendar beginning with March, 1905, and ending with February, 1906. The calendar pad is fifteen inches by twenty-two and one-half inches, and the figures are one and one-half inches high. The illustration shows a view of Niagara falls from the Michigan Central trains. All trains passing Niagara Falls by daylight stop five minutes at the Falls View Station. Mr. G. J. Grammer is vice-president and general traffic manager, Chicago, Ill.; R. H. L'Hommedieu, general manager, Detroit, Mich.; C. F. Daly, passenger traffic manager, Chicago, Ill.; O. W. Ruggles, general passenger and ticket agent, Chicago, Ill., and W. H. Underwood, general eastern passenger agent, Buffalo, N. Y.

INDUSTRIAL SECTION.

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

The Queen Standard Potentiometer.

Queen & Company, Incorporated, Philadelphia, Pa., have placed on the market their latest improved electrical testing instrument, which they have designated as the Queen standard potentiometer. The containing-case is of carefully selected, thoroughly seasoned, polished mahogany.

THE QUEEN STANDARD POTENTIOMETER.

The top plate is of heavy rubber sheet of the best grade, polished and engraved with distinct numbers on corrugated rubber blocks. These blocks are also highly polished. This renders the insulating surfaces of extra length, making them easily cleaned and of good appearance. Each of the studs over which the silding contact arm moves is heavily faced on the upper surface, and the brush is mounted in the sliding arm which makes contact with the surface of the stud and ring.

By employing the ring, the necessity of using a stud supporting the handle as a part of the electrical circuit is obviated. The rubber handles are round and easily grasped. The brushes are built up of thin laminations of spring phosphor-bronze, and are accurately ground into contact with the faced stud. Each of these brushes can be removed by slipping aside a steel spring which holds it in place. The switch arms are numbered, and a corresponding number is placed on the end of the brush next to it, so that they can be replaced without difficulty.

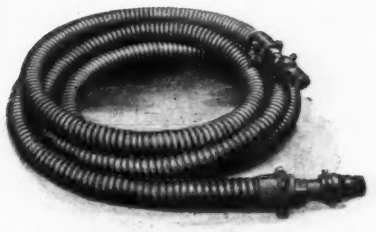
The sliding surfaces are large and ground together to such perfect contact that any variation in this resistance may be disregarded. The moving switch contacts are accessible and readily removable. The resistance coils are wound on metal spools, which are very rigid and permit an even distribution of heat.

Three pairs of terminal binding-posts are provided for various standard cells, one pair being for the Carhart-Clark cell, one pair for the cadmium cell, and the third pair for any standard cell which may be used. In order that the resistance of each cell may be independently determined, a tapered hole is drilled in each stud, in which a traveling plug fits, for connection to outside measuring instruments. The switches are so arranged that one or more standard cells may be connected to their respective terminal boards at the same time. They can not be interconnected, however, nor more than one used at the same time.

A double-pole, double-throw switch shows at once whether the standard cell or the unknown electromotive force is connected in the circuit. By throwing this switch to the side marked "standard," the strength of the current passing through the potentiometer can be checked. This can be done in the case of the Carhart-Clark and cadmium cell, regardless of where the main switch stands.

Flexible Steel-Armored Hose.

The Sprague Electric Company, 527 West Thirty-fourth street, New York city, has placed on the market a new product, to meet the demand for a steam or air hose which could be absolutely relied upon to withstand mechanical injury. The Sprague company's new product is known as flexible steel-armored hose. This consists of a suitable rubber hose encased in a steel armor, which prevents expansion, and thus greatly increases the life of the hose. It also protects the hose from mechanical injury, and ensures flexibility by making it impossible to flatten or kink when handled. Should over-vulcanization occur during the service of the hose, the steel armor binds the rupture so tightly that very little pressure is lost, and the work in progress does not stop. This permits the hose to be used until a new piece can be obtained.



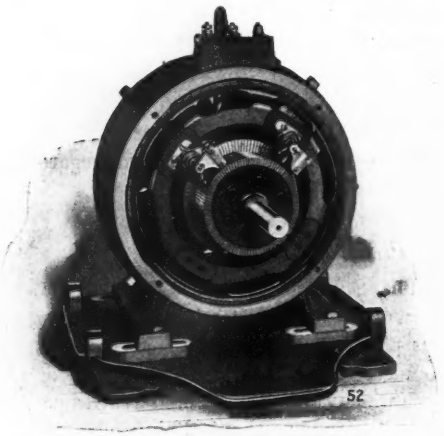
COIL OF FLEXIBLE STEEL-ARMORED HOSE.

VIEW OF ARMOR CONSTRUCTION.

The Payne Company, Havemeyer Building, New York city, is distributing a reprint from the *Engineering Magazine*, entitled "The Economy of Isolated Electric Plants."

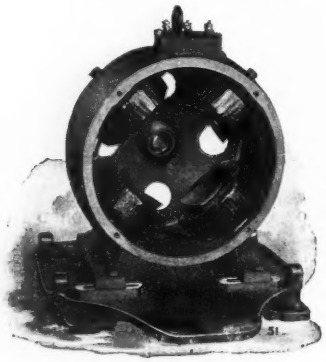
Small Multipolar Motors.

The Diehl Manufacturing Company, Elizabethport, N. J., has placed on the market a line of small multipolar motors.



TYPE "E" MOTOR, FRONT COVER REMOVED.

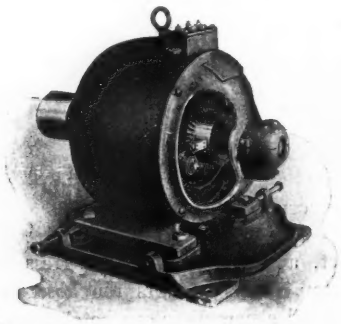
These are compact and symmetrical in appearance, and adapted for special as well as general power purposes. Two types have been designed, designated as



TYPE "E" MOTOR FRAME.

"D" and "E" motors. The accompanying illustrations show both types of motor in assembly and in detail.

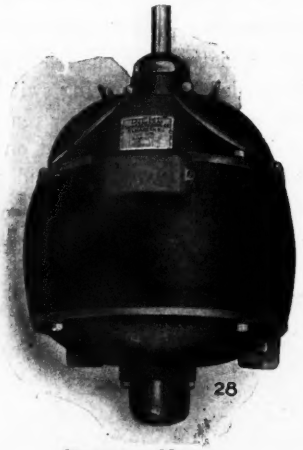
Particular attention has been paid to



TYPE "D" MOTOR, OPEN.

detail of construction, as well as to high efficiency, low heat limits and sparkless operation. The machines run up to twenty-five per cent overload without change in the position of the brushes.

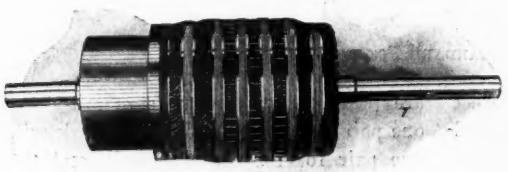
The yoke is circular in form, and is of soft cast steel of high magnetic quality, in the machines from three to twenty-five horse-power. The smaller sizes, up to



VERTICAL MOTOR.

and including two-horse-power machines, are of cast iron, with poles cast integrally with the yoke. Machines from two horse-power to twenty-five horse-power are multipolar, and all sizes smaller than this are bipolar.

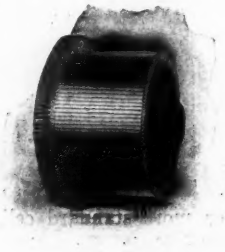
In the frames having steel yokes, the magnetic cores are separate and are of steel with cast-iron pole-pieces. The pole-



TYPE "E" ARMATURE COMPLETE.

pieces are of such form as has been shown by careful experiment to give the best distribution of the magnetic flux.

The end covers are secured to the yoke by four bolts, and the bolt holes are so spaced that the covers may be rotated



COMMUTATOR,

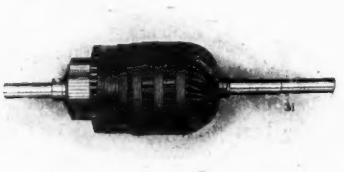
one-quarter or one-half a revolution and retain the oil chambers in their proper positions, when it is found desirable to fasten the motor to a side wall or to a ceiling. Upon the arrangement of the end covers depends the style of the motor, whether semi-enclosed, enclosed with screens, or entirely enclosed. The semi-enclosed motor has openings for ventilation, though the motor is well protected. The enclosed motor with screens has the openings covered with a fine wire screen, the mesh of which is small enough to protect the motor from small flying particles. The entirely enclosed motor is air-tight, and is for use where extreme moisture or injurious vapors would damage the motor. The rating of the

FIELD COIL.

entirely enclosed motors is lower, on account of the decrease in the ventilation and consequent increase in heating.

A rocking ring replaces the old style rocker arm, giving a neat appearance, adding rigidity to the brush-holder, and providing easy access to the commutator for cleaning.

The armature core is of the slotted



TYPE "D" ARMATURE COMPLETE.

drum type, and is made up of thin plates of soft steel of the highest magnetic permeability. The plates are slotted to the size required for the coils, after which

BRUSH-HOLDER.

they are carefully annealed and varnished. They are then assembled directly on the shaft, and, in the larger sizes, ventilating ducts are provided for proper circulation of air through the core. The armature

coils are machine-wound, and carefully insulated, taped, baked and varnished. Each coil, with its insulation, is self-contained and a complete unit in itself. There is no insulation in the slots.

The commutator is made of drop-forged or hard-drawn copper bars, carefully insulated with mica. The bars and mica are assembled in a ring especially made for the purpose. After being heated and compressed to the greatest possible degree, all surfaces are bored and turned. The ring is not removed until the brush is in place and carefully tightened. The proportions are ample, giving a low current density in the brushes, and making a large allowance for wear.

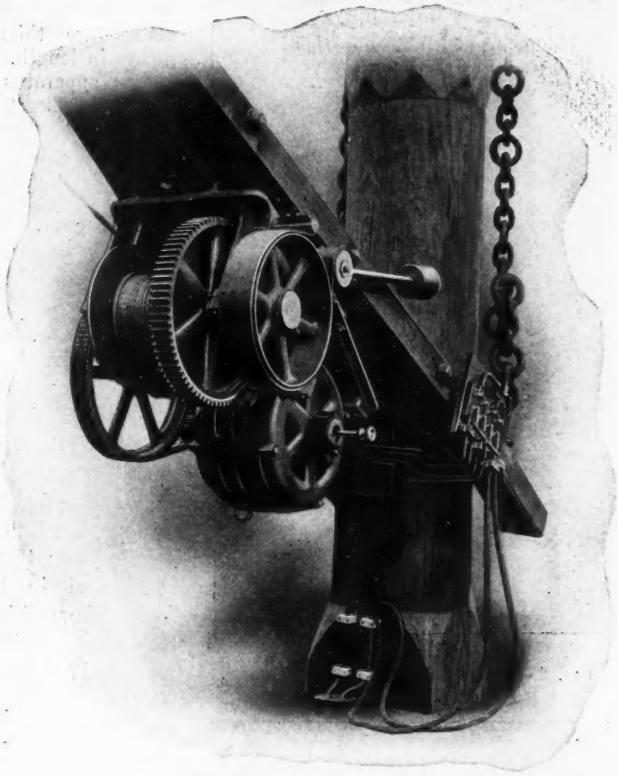
The field coils are form-wound, and heated to drive out all moisture. They are then dipped in insulating varnish and baked, after which they are insulated and taped. The bearings are of bronze, of ample dimensions, and are self-aligning and self-lubricating. Two rings in each bearing are continually carrying oil to the shaft, in such quantities that there is no chance of overheating. The bearing caps are provided with openings to allow of examination of the rings at all times.

The brush-holders are of the box type, simple and easy of adjustment. The brushes, which are of carbon, can be readily removed while the machine is running. The carrying capacity of both brushes and holders is ample, ensuring low temperatures. On the larger sizes a flexible lead connects the brush with the holder in such a manner that freedom of motion is not interfered with. At the same time, a solid joint between brush and holder is assured.

An Electric Derrick Winch.

The accompanying illustration shows the improved electric derrick winch, equipped for either alternating current or direct current, placed on the market Messrs. Dievelt & Eisenhardt, Incorporated, Philadelphia, Pa. This winch has been designed to provide a light but powerful lifting mechanism, easily applied and well adapted to either guyed or stationary mast and boom derricks.

The apparatus consists substantially of one main casting forming a bearing and support for the cable drum, countershaft, journals and motor, this casting being of proper shape to fit the underside of the gaff or boom. The casting is held in place by bolts extending through heavy cast-iron straps on the top side of the boom, forming a complete self-contained piece of apparatus, requiring only the wiring connections to make it ready for operation. Power is transmitted from the motor to the countershaft by a silent chain drive, and from the countershaft to the drum shaft by cut spur gears. The motor may be either direct or alternating current, of five horse-power, and should operate at a speed not exceeding 1,200 revolutions per minute.



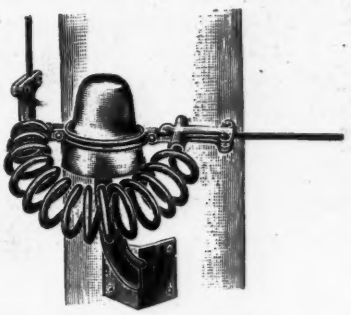
ELECTRIC DERRICK WINCH.

The method of control may be either an electric controller, varying the motor speed, which requires starting the motor from stand-still for each load hoisted, and the use of an electric brake with a hand attachment for lowering; or keeping the motor in operation continuously while the derrick is in use, and controlling the load with a powerful friction clutch and hand brake. Either of the above systems is practicable with direct-current motors. When induction motors are used, however, only the latter system is available.

The lifting capacity of the apparatus is 165,000 foot-pounds, and the approximate weight of the winch is 1,350 pounds.

The "Vitae" Stirrup.

The "Vitæ" stirrup is a safety device for arc light circuits, manufactured by the White Star Appliance Company, 1330 Kenmore avenue, Buffalo, N. Y. The apparatus is not designed to give a trouble signal or act in any way as an indicator, but the manufacturer claims that it is a positive trouble preventer. In places where the wires are subject to bending strains, particularly in the installation of arc lamps, and wherever open circuits are liable, this apparatus will eliminate breaking of the conductor.



"VITÆ" STIRRUP.

The stirrup is made of malleable iron, galvanized, and the parts are fastened together by galvanized bolts. The apparatus is equipped with a glass insulator or porcelain knob, as the service may demand.

Apparatus for the New Power-House of the Ohio Street Railway System.

The Toledo Interurban Construction Company has recently awarded to the Allis-Chalmers Company, Milwaukee, Wis., the contract for the complete equipment of the new power-house of the Toledo, Port Clinton & Lake Side Railway at Port Clinton, Ohio, including two 1,280-horse-power Reynolds-Corliss engines, two 800-kilowatt Bullock alternating-current generators; two fifty-kilowatt Bullock direct-current generators; one 400-kilowatt Bullock alternating-current rotary converter; two Tomlinson barometric condensers, and boilers, pumps, heaters, etc. The contract calls for the completion of the plant in every detail by or before July 1, and is noteworthy from the fact that of the very varied equipment to be furnished the greater portion will be constructed in the manufactories of the successful bidders. Bullock railway motors have been in successful operation on this road for some time past.

A New Type of Combination Fan.

The accompanying illustrations show a new form of column and electrolier fan which is being placed upon the market by the Essex Electric Company, of Newark, N. J. Fig. 1 and Fig. 2 represent column fans, and Fig. 3 and Fig. 4 show two forms of ceiling electrolier fans.

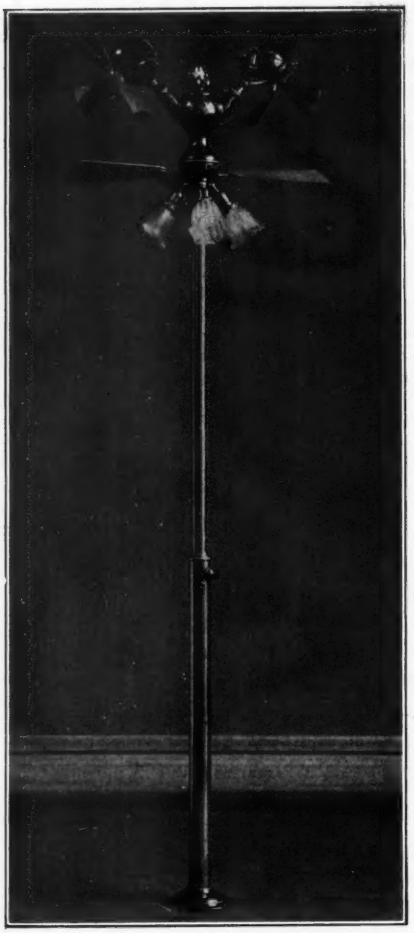


FIG. 1.—COLUMN FAN AND ELECTROLIER.

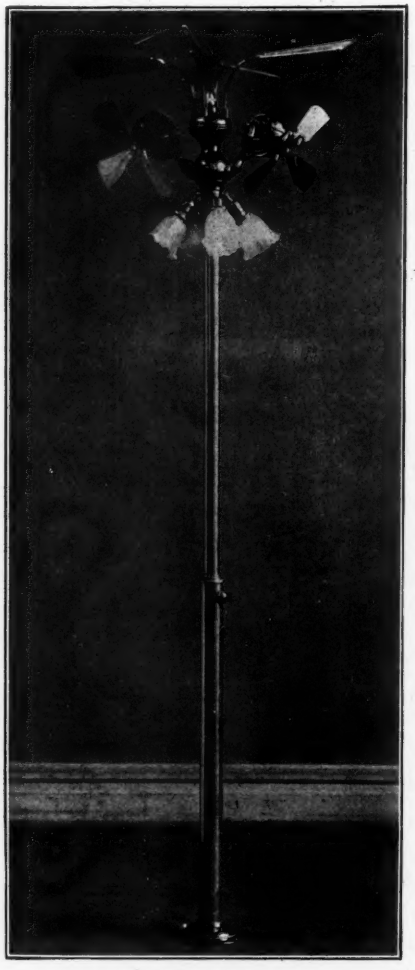


FIG. 2.—COLUMN FAN AND ELECTROLIER.

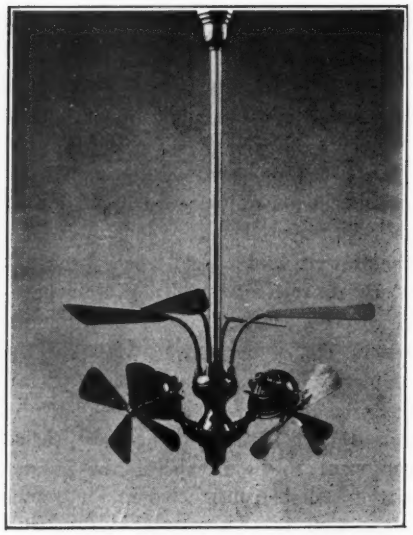


FIG. 3.—CEILING FAN AND ELECTROLIER.

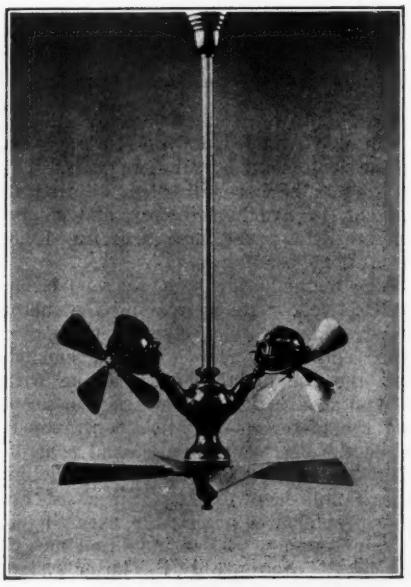


FIG. 4.—CEILING FAN AND ELECTROLIER.

The particular feature of this apparatus is that the smaller fan motors may be set so as to distribute a blast of air in any fixed direction, or may revolve so as to distribute air over a wide area. As the smaller motors revolve in the one direction, the wooden blades revolve in the opposite direction. This is made possible by a very simple gear train located in the expanded portion of the column, either just above or just below the large fan blades. The fans have two direct speeds, and when revolving in opposite directions, the ratio of the two sets of fans is as nine to one. The fan blades on the small motors are twelve and fourteen inches in diameter, and the large blades are thirty-two and thirty-four inches in length.

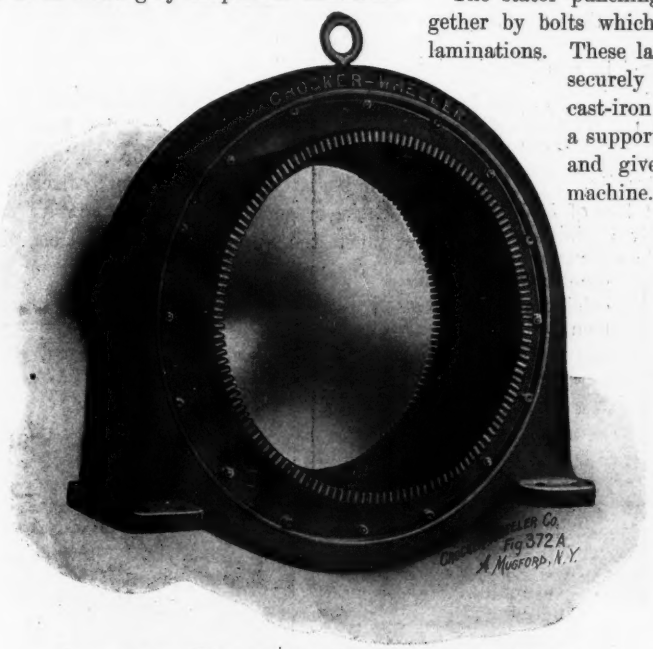
The apparatus is made for 100 and 130 volts direct current, 220 and 250 volts direct current, and 115 volts alternating current. The fans are finished in black japan with gold trimmings. The New York city sales office is at 120 Liberty street.

Fast Railroad Service as a Business Aid.

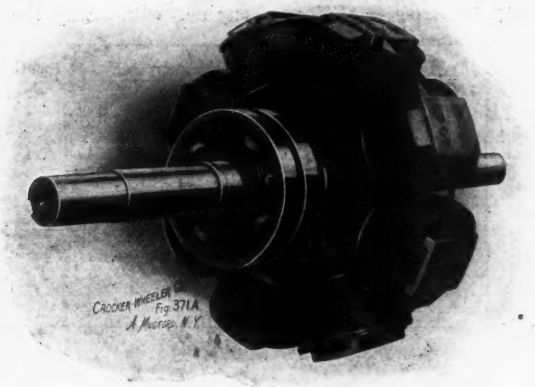
Mr. Albert M. Bigelow, of New York, writes in regard to a trip from New York to the Lake Superior mining region as follows: "I was absent from my office in New York Friday, Saturday and Monday. I had one day in Chicago, two days and a night at Lake Superior, and did not need to break the Sabbath by any business transaction. This was accomplished in this way: I took the Lake Shore Limited for Chicago on Thursday evening, leaving at 5.30. I arrived in Chicago at four o'clock on Friday. I stayed in Chicago four and one-half hours, meeting some people there and accomplishing some business. I took the train at 8.30 and arrived at Lake Superior at 6.50 in the morning. I had all day Saturday and the evening there. I spent Saturday night there and Sunday. Sunday evening at 6.50 I left Lake Superior and arrived at Chicago on Monday morning at six o'clock. I had a half-day there and left at 12.30 P. M. on the Twentieth Century Limited on the Lake Shore road for New York, arriving at 9.30 Tuesday morning, which enabled me to reach my office at the ordinary time. On each of the trains which I took I had a comfortable room for myself and was luxuriously supplied in dining cars on each road. This more than verified the story in the 'Arabian Nights' of the wonderful Persian carpet on which the Prince was transferred some one hundred miles in a single night." Mr. Bigelow adds that the above is in striking contrast to his first trip to the Lake Superior region in 1859, when it occupied seven or eight days of constant traveling in going one way.—*Troy Times.*

Belt-Type, Alternating-Current Generators.

The Crocker-Wheeler Company, Ampere, N. J., is placing on the market a line of belt-type, alternating-current generators. Arrangements have been completed for the cooperation of Messrs. Brown, Boveri & Company, of Baden, Switzerland, as consulting engineers, to take up the manufacture of alternators at the advanced point reached by them. The Crocker-Wheeler Company's output of alternating-current machinery is stated to be as thoroughly adapted to conditions in the United States as its long-established line of direct-current apparatus.



STATOR WITH WINDINGS FOR SIZE 100-KILOVOLT-AMPERE BELT-TYPE ALTERNATOR.



COMPLETE ROTOR FOR 100-KILOVOLT-AMPERE BELT-TYPE ALTERNATOR.

The standard compound-wound, direct-current generators are used as exciters at conservative ratings, in view of the fact that they are called upon to furnish the excitation, under severe conditions of overload and low power-factor. They are furnished with rail base and pulley for belt drive from the main generator shaft. Each generator is furnished with the field rheostat, base frame, rails and two pulleys. The machines, when wound either two or three-phase, will carry their full-rated load at unity power-factor for twelve hours with a rise of temperature not exceeding forty degrees centigrade in any part of the machine, and will carry a twenty-five per cent overload at unity power-factor for two hours with a rise of temperature not exceeding fifty-five degrees centigrade. The inherent regulation of this machine will not exceed eight per cent for a full non-inductive load.

These belted alternating-current generators are of the revolving type, running at speeds which were selected with reference to safety and satisfactory operation. The cast-iron frame supporting the armature punchings is mounted on a substantial iron base. To this base are bolted pedestals properly proportioned for the speed and output of the generators.

The revolving element consists of a rotor mounted on a stiff shaft of selected steel. Two pulleys are provided on the shaft, one for the main drive and one for the exciter.

The stator punchings are clamped together by bolts which pass through the laminations. These laminations are then securely attached inside a cast-iron shell which forms a support for the punchings and gives a finish to the machine.

A characteristic feature in the design of these alternators is the use of a partly closed slot. This type of slot makes it possible to reduce materially the weight of an alternator for a given rating, without affecting the behavior of the machine, and gives the additional advantage of a reduction in the total losses, which means a corresponding increase in the efficiency. The slot is lined with a heavy tube of insulating material, which is prepared and treated so that it becomes very hard, tough, and possesses the requisite dielectric strength to meet the insulation requirements. These tubes conform to the shape of the slot very closely, so as to have available a maximum of space for the winding. The top of the tube is slotted to correspond with the top of the slot.

The stator coils are form-wound, being slipped through the narrow opening at the top of the slot, and then arranged systematically in the insulating tubes. After the conductors are put in place, a wooden wedge is driven over the top of the insulating tube so as to close this tube and retain the conductors securely in place. The coil ends are then heavily taped and insulated in order to give protection and add a finish to the coils.

To give additional protection to the stator winding and add to the appearance of the machine, shields are attached to the side of the frame and project just beyond the winding.

The revolving element, excepting the pole-shoes, is one solid steel casting. The pole-shoes are made of forged steel and bolted securely to the projecting pole cores. Because of the partly closed slot solid pole-shoes can be used. These solid shoes greatly facilitate the parallel operation of machines, which is an important consideration, as generators are more frequently run in parallel than singly.

On sizes of 200-kilovolt-amperes and larger, the rotor coils are made of copper strip wound edgewise. The layers are insulated from each other by means of paper, and an insulating compound, after which the whole coil is carefully baked. A coil of this kind will withstand without injury the severe mechanical strain, and the great overloads to which machines of this class are subjected. On machines below 200-kilovolt-amperes the rotor is wound with square copper conductor, special care being given in winding and insulating to make them perfect.

The collectors used for leading in the exciting current to the rotor coils consist of cast-iron rings mounted on a cast-iron shell, which is fitted to the shaft. These rings are carefully insulated from the shell by means of porcelain bushings, and the entire construction is such that the rings can be easily inspected and cleaned.

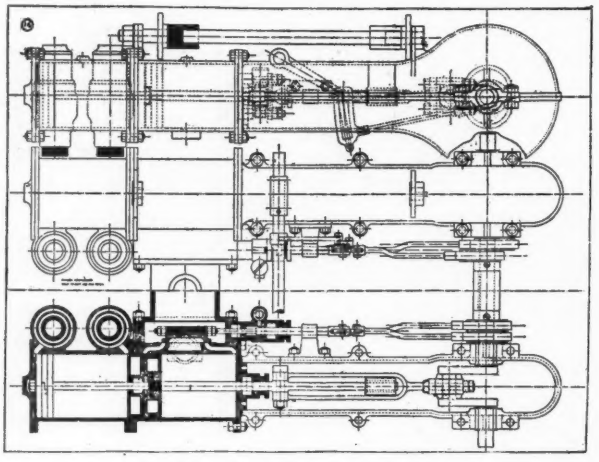
All of these machines are carefully tested before shipment and are guaranteed by the Crocker-Wheeler Company to be in perfect condition when they leave the works. The guarantee includes the rating, stability and performance of the apparatus, and the company stipulates that it will, without charge, during a period of one year from the date of shipment, repair or, at its option, furnish to the purchaser a new part in exchange for any part of the machines of its manufacture that, under normal conditions of operation, and under proper supervision and attendance, develop any mechanical or electrical defect.

THE SVEA CALORIC ENGINE.

BY G. EMIL HESSE.

Cool air, split up into limited portions, and rapidly heated by being forced over a hot surface, is the foundation of the system which has been adopted for the Svea engine. The engine is self-starting, double-acting, reversible, and is regulated like a steam engine, making 450 revolutions per minute. A six-horse-power Svea engine is now being built, applicable for laundries, automobiles, etc., and a 100-horse-power stationary engine is in preparation. The six-horse-power engine has two cylinders, with a diameter of four and one-quarter inches and a stroke of four and seven-eighths inches.

The heater is twenty inches in diameter, sixteen inches long, with a heating surface of sixty square feet. The engine and heater complete weigh 450 pounds. A one-half horse-power Ericsson engine, with a cylinder ten inches in diameter, weighs 1,700 pounds and makes seventy-five revolutions per minute. This is the handicap with which that type has been hampered and which makes it an impossible proposition for even a few horse-power.



THE SVEA CALORIC ENGINE.

The Svea engine consists of a power cylinder and an air pump. The cool air is drawn in from the atmosphere for small sizes and pumped into a heater, where it is forced over the heated surface well divided up, which causes it to rapidly absorb the heat. The air heated to a temperature of about 430 degrees centigrade goes then into the power cylinder, where it does the work, and from there to the atmosphere.

The large stationary and marine type works with the air at a pressure of 100 pounds per square inch, using the same air over and over again, alternately heating and cooling it. The same system of heating it is, however, employed, no dependence being placed on the mere rising of the warm air into the cooler above.

The Svea engine does not expose a larger surface per horse-power than the steam engine and the heater utilizes all the available heat as perfectly as any steam boiler. All conditions consequently being equal, the saving by the hot air engine would be the amount of heat required to vaporize the water, minus the heat recovered by condensation. One kilogramme of 100 degrees centigrade water requires 537 thermal units in order to convert it to steam of the same temperature.

The heat recovered by condensation is:

$$\frac{10{,}334 \times 1{,}649}{424\left(\frac{10}{9}-1\right)}\left[1-\left(\frac{1{,}649}{14.55}\right)^{\frac{1}{9}}\right]=$$

76 units,

making a total net loss of 537—76=461 units, which clearly explains the reason why the best triple expansion steam engine only shows an efficiency of fourteen per cent.

The cylinder of the Svea engine does not require any cooling water, which is the cause of a very large loss in the gas engine.

The theoretical efficiency of the Svea engine with the air at 430 degrees and the exhaust at forty degrees is:

$$1-\frac{273+40}{273+430}=0.56=56 \text{ per cent.}$$

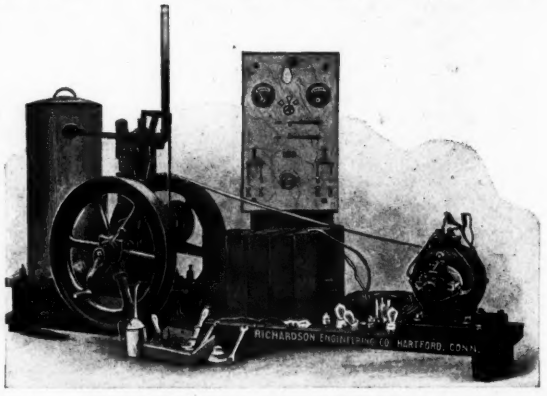
The Use of the Wright Demand Meter.

The Edison Electric Illuminating Company, Boston, Mass., which began, in 1898, to experiment with the Wright demand system of charging, has steadily extended its use, and is now making a final extension of the system to all its customers, both for light and power. Up to the present time the Wright demand indicator has been used only to measure the demand of customers having fifteen lights or more installed. Its use now is to be extended to measure the demand of all contract customers having five or more lights. To meet the above extensions, over 4,000 Wright demand indicators will be required, orders for which have been placed with the General Incandescent Arc Light Company.

With the extension of the Wright demand system, the Edison Electric Illuminating Company, of Boston, will put into effect a scale of rates which, it is expected, will do away with the inconvenience and expense of figuring out what rate a customer is entitled to. This new scale of rates is designed to automatically give to each customer the proper rate—that is, a rate having, as nearly as possible, a definite ratio to the cost of supplying him.

Small Electric Light Equipments.

The Richardson Engineering Company, 36 Pearl street, Hartford, Ct., builds complete electric light plants suitable for house or small marine work. With each outfit the company furnishes complete plans and directions for setting up and operating the plant, so that any person of average intelligence can install and run an equipment up to a capacity of 100 lights.



COMPLETE ELECTRIC LIGHT EQUIPMENT.

The line of equipments made by this company ranges from 4 to 1,500 lights capacity, and the generators may be driven either by steam, gas or gasoline engines. For example, the company's No. 5 outfit consists of a six-horse-power, throttle-governed gas or gasoline engine, with an extra heavy flywheel, cooling tank, supply tank, pipe and foundation bolts, a semi-enclosed dynamo, a belt, a 160-ampere-hour storage battery, and a switchboard complete with pilot lights, instruments, voltmeter switch, counter-cell switch, rheostat, underload circuit-breaker and switches. The switches are so arranged that any desired combination of generator and battery may be secured. The engine may be run at full load as long as it is desired, the battery being charged when the load is not heavy enough to use the entire output of the machine.

The accompanying illustration shows a No. 3 twenty-light outfit, which is suitable for a residence.

CURRENT ELECTRICAL NEWS

DOMESTIC AND EXPORT.

EDISON COMPANY IN GERMANY—A new American stock company was incorporated in Berlin on March 4, under the name of "The German-American Edison Accumulator Company." The paid-up capital of the new company is 3,000,000 marks and Thomas A. Edison is one of the directors.

MEXICAN LIGHT AND POWER COMPANY ISSUES BONDS—The Mexican Light and Power Company is issuing $1,000,000 additional bonds to provide for the construction of a few branch lines into the mining districts of Mexico. This will make $8,500,000 of the authorized total of $12,500,000 bonds which the company has in the treasury.

NEW ELECTRIC ROAD IN ARGENTINE REPUBLIC—An electric tramway is projected for Buenos Ayres, to run from the Plaza Mayo to Androgue and other suburbs in that direction. It is the first enterprise of the kind in which Argentina capital only is to be employed. The promoters are J. B. Mignaguy, B. Villasueva, J. M. Massini and D. S. Hale.

SALE OF MEMPHIS STREET RAILWAY—Announcement is made of the sale of the Memphis Street Railway Company to the firm of Ford, Bacon & Davis, engineers, of New York city. The purchase price is stated to be approximately $4,500,000. George H. Davis succeeds C. K. G. Billings, of Chicago, as president of the company. Mr. Billings was one of the largest stockholders.

ELECTRICITY IN THE STRAITS SETTLEMENTS—Several electric lighting and power projects are proposed for towns in the Straits Settlements. An installation at Kuala Lumpur is estimated to cost $880,000. The town of Ipoh has appropriated $90,000 for an electric plant. The Howarth-Erskine Company, Limited, of Singapore, recently secured large contracts for an electric installation of the Sultan of Perak's palace at Kuala Kangso and for an additional plant at Penang. At the latter place an electric tramway is being built to supersede horse-drawn cars.

WIRES IN WASHINGTON TO BE PUT UNDERGROUND—Congress having granted the various telephone and electric companies, operating in Washington, D. C., the right to lay conduits, the district commissioners have ordered all wires in the city to be placed underground. Work is to be started at once, and is to be completed in five years. Telegraph companies have been given the right to use telephone conduits. The Postal Telegraph Company will use the telephone conduits, while the Western Union Company will lay conduits of its own.

NORTHWESTERN TELEPHONE COMPANY TO IMPROVE ITS LINES—The Northwestern Telephone Exchange will expend $1,000,000 for improvements on the system in North and South Dakota and Minnesota during the present year. Upward of $400,000 will be expended in North Dakota, almost entirely in the construction of new lines. The principal line is to be from Jamestown to Bismarck and Mandan, which will give long-distance connection from Dickinson to the Twin Cities. There will be several other lines constructed, but all of these have not been definitely decided upon as yet.

TELEPHONE SYSTEM FOR THE CHICAGO & ALTON RAILROAD—A contract between the Chicago & Alton Railroad and the Bell Telephone Company has been signed providing for the construction of a complete telephone system over the entire Alton lines. To begin with fifty exchanges will be established, the central exchange being located in East St. Louis, Ill. From this station the lines will ultimately be operated over the road north to Chicago and west to Kansas City, with lines to the different branches. The construction of the new system will be started in about two weeks. It is not the intention at present to use the telephone service in the operation of trains. The value of the telephone is in the handling of messages relating to traffic, principally freight.

WHEELING, W. VA., TROLLEY, LIGHT, WATER AND BRIDGE PROPERTIES TO BE CONSOLIDATED—A merger of city and suburban tractions, electric light, water and bridge properties of the city of Wheeling, W. Va., has been announced. The deal involves properties valued at $7,000,000 and the plan is to put all the separate companies into one new corporation which will control the entire city railway system and all the suburban traction lines running into the city, also the electric lighting plants and the waterworks. The companies that have been bought outright and will be taken over in the merger are: the Wheeling Traction Company; the Wheeling & Elm Grove Traction Company; the City Railway, Wheeling; the Suburban Water and Light Company, Wheeling; the Steubenville, Mingo & Ohio Traction Company; the Wheeling Bridge Company; the Wheeling & Western Traction Company, and the Wheeling & Western Park Association.

BALTIMORE ELECTRIC LIGHT COMPANY FILES MORTGAGE—A trust mortgage for $7,500,000, from the Baltimore Electric Power Company to the Northern Trust Company of Philadelphia, Pa., has been recorded to secure an issue of $7,500,000 five per cent gold bonds, to run thirty-four years. The proceeds will be used to erect a power-house and to purchase the outstanding bonds of the Maryland Telephone and Telegraph Company. A majority of the stock of the Telephone and Telegraph Company is owned by the Power Company. The plans for the expenditure of the money are as follows: for a new plant, now in course of construction, $2,245,000; to redeem the first mortgage bonds of the Maryland Telephone and Telegraph Company, $1,000,000; to take up the outstanding general mortgage bonds of the same company, $1,155,000; to redeem the ground rent on the American Telephone Company building at Lexington and Courtland streets, $100,000; for future extensions and improvements, including increased electric power, $3,000,000, bringing the total up to the issue of $7,500,000, as provided. The company expects to be ready to supply electric current by July 1. The Standard Underground Cable Company, of Pittsburg, Pa., is placing the wires in the conduits for the Power Company. Several gangs of men are now engaged in the work, and about $200,000 worth of wire is in position.

FINAL SURVEYS FOR THE NEW YORK, WESTCHESTER & BOSTON RAILWAY—The New York, Westchester & Boston Railway Company has begun its final surveys for the route between Mount Vernon and Port Chester. This work is being conducted under the general supervision of Mr. J. C. Cryder, the company's division engineer, located at Mount Vernon. This is in addition to the preliminary surveys which were made over the Westchester county part of the route last year when three lines were laid. In special charge of the new work is Mr. F. Lavis, resident engineer, with the following staff: W. B. Leonard, assistant engineer; Ernest J. Howe, transitman; W. T. Snodgrass, levelman; I. R. Hall, transit rodman; Peter Krudler, Jr., level rodman; Frank Lamb and A. D. Berstler, chainman; P. Bible, axeman. At the present time five corps of engineers in all are at work for the company, three operating in the borough of the Bronx, one on the branch from Mount Vernon to White Plains, and the additional squad mentioned above, from Mount Vernon to Port Chester. The company is rushing forward this work of making its final surveys, in order that every preparation may be made for pushing the work forward as rapidly as possible during the coming spring. A large section of the right of way in New York city has been purchased during the past ten days. The entire route within the city limits, except in crossing streets, must be over private right of way.

ELECTRICAL NOTES FROM MEXICO—The aldermen of the city of Tlaxcala and the governor of the state, Colonel Cahuantzi, are constructing a hydraulic work near the city, which will produce 300 horse-power. The project consists of utilizing the waters of the Zahaupan river by a canal starting from a point near San Pablo Apetatitlan, 700 metres long, two metres wide, and the necessary depth according to the topography; a tunnel 420 metres in length,

and an immense reservoir, with capacity for 1,280 cubic metres of water. The power will be applied to various industries to be established near the city of Tlaxcala. The work was commenced about two years ago, and over $50,000 has been already expended on it. William V. Backus, of Cleveland, Ohio, and J. N. Zermeno, of Mexico City, respectively vice-president and general manager of the recently organized Jalisco & Michoacan Railway Company, at which they agreed with Governor Ahumada that construction of the electric road from Guadalajara to Lake Chapala will be commenced following the rainy season next October. The concession allows five years for the completion of the road, but the company expects to have it finished in little more than a year after work is started. A second link of the road is to be built from a point on the southern shore of Lake Chapala to Morelia, the capital of the state of Michoacan, and steamers are to be operated across the lake between the terminals.

EXPRESS TROLLEY LINE PROPOSED BETWEEN NEWARK, N. J., AND NEW YORK—Thomas N. McCarter, president of the Public Service Corporation of New Jersey, has issued a signed statement in which he says that if the New Jersey legislature authorizes the abandonment of navigation upon the Morris canal, and permits the sale of the property of the canal company and its diversion to other public uses, the Public Service Corporation will endeavor to acquire so much of the roadbed or right of way of the Morris canal as lies within the city of Newark and northwest of the city as far as Bloomfield. It will proceed also to acquire, by purchase or condemnation, whatever private or reversionary rights there may be in the canal bed, and devote the property to subway purposes free from grade crossings, and operate therein high-speed trains similar to those in use in the New York subway. Stations will be constructed at proper points in the lower portion of the city, and in such portions of the northwesterly section of the city as are traversed by the bed of the canal. There will be connection by transfer, without extra charge, on all local fares, with the surface lines using the streets. The company will also connect this right of way with a private right of way across the meadows, which it has already acquired, and will build a high-speed line to and through Jersey City over a route already surveyed, to a point where it will connect with the new tunnels now being constructed to various portions of New York city. It will thus give a new route and direct connection to different parts of New York city from the portions of Newark above referred to, as well as furnishing rapid transit between Newark and Jersey City, and between the entire Hudson hill and New York city. Negotiations to this end between the companies controlling the tunnels and the Public Service Corporation are now awaiting the result of legislation for the abandonment of the canal.

ENGINEERING SOCIETIES.

THE ENGINEERS' CLUB, OF ST. LOUIS—On Wednesday evening, March 15, at the regular meeting of the Engineers' Club, of St. Louis, Mr. Lionel R. Viterbo delivered a lecture upon "Fundamental Principles of Reenforced Concrete."

TORONTO BRANCH OF THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS—The sixteenth regular meeting of the Toronto branch of the American Institute of Electrical Engineers will be postponed until March 24, but as per arrangement with the Engineers' Club a joint meeting of the American Institute of Electrical Engineers and the Engineers' Club was held at the club-rooms of the latter, 96 King street West, on Thursday evening, March 9, at 8 P. M. Mr. H. A. Moore introduced for discussion Mr. Mershon's paper upon the "Maximum Distance to Which Power Can Be Economically Transmitted."

THE STEVENS CLUB OF NEWARK—The Stevens Club of Newark (N. J.), was organized with a membership of about thirty on March 10, 1905, at a meeting held at Stetter's restaurant. The organization is composed of the graduates and upper classmen of the Stevens Institute of Technology who reside or are in business in the vicinity of Newark, N. J. Meetings are to be held every month, at which papers on engineering subjects will be presented and discussed. The officers elected were: president, Frederick C. Fraentzel; vice-president, Edwin R. Douglas; secretary and treasurer, Arthur P. Hagar. The next meeting will be held on April 14, and Mr. E. R. Douglas, of the Crocker-Wheeler Company, will present a paper on "Motor Driving of Machine Tools."

AMERICAN SOCIETY OF MECHANICAL ENGINEERS—The transactions of the American Society of Mechanical Engineers for 1904 are being distributed. These form vol. xxv, and contain, among a goodly number of valuable papers, several which are of interest to electrical engineers. A paper by Frank B. Perry is entitled "A Method for Determining Rates and Prices for Electric Power." Another, by Benjamin T. Allen, is entitled "Construction and Efficiency of a Fleming Four-Valve Engine Directly Connected to a 400-Kilowatt Generator." "Commercial Gas-Engine Testing and a Proposed Standard of Comparison" is the title of a paper by William P. Flint. J. H. Wells discusses "The Power Plant of the Tall Office Building," and the same subject is considered by R. P. Bolton. "Different Applications of the Steam Turbine," the valuable paper by A. Rateau, is here given with one by W. L. R. Emmet on "Steam Turbine in Modern Engineering," and one by E. S. Lea and E. Meden, on "The De Laval Steam Turbine." "The Middlesboro Dock Electric and Hydraulic Power Plant" is described by Vincent L. Raven, and "Refuse Destruction by Burning, and the Utilization of Heat Generated," by C. N. Russell. Another paper on the same topic is contributed by George Watson. This volume contains also the presidential address of James M. Dodge, entitled "The Money Value of Technical Training."

WASHINGTON UNIVERSITY BRANCH, AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS—The first regular meeting of the St. Louis branch of the American Institute of Electrical Engineers, since the close of the World's Fair, was held in the rooms of the Engineers' Club on Wednesday evening, March 8, with an attendance of twenty-three members and visitors. The chair was occupied by Mr. H. H. Humphrey in the absence of the regular chairman, Professor W. E. Goldsborough. The branch organized for the year by electing a new executive committee of five members, composed of the following gentlemen: Messrs. H. H. Humphrey, W. A. Layman, A. S. Langsdorf, G. Swope and R. McCulloch. At a meeting of this committee held later Mr. Humphrey was elected chairman and Mr. Langsdorf, secretary. A discussion as to the work to be undertaken during the year was participated in by many of those present. It seemed to be the prevailing opinion that a continuation of the former policy of reading and discussing the regular Institute papers would be best, but that papers by local members should be encouraged as much as possible. A committee consisting of C. R. Meston, chairman, C. Marshall, W. A. Baehr, R. McCulloch and F. R. Mott was appointed to secure new members, with the object of having the local electrical industry represented as fully as possible. The paper of the evening, on "Electrical Engineering at Washington University," was then presented by Mr. A. S. Langsdorf. After some discussion the meeting adjourned.

NEW PUBLICATION.

ELECTRICAL TRADES DIRECTORY AND HANDBOOK FOR 1905—The 1905 issue of the "Big Blue Book," published by the Electrician Publishing Company, London, England, is now ready. This is the twenty-third year of this directory of the electrical engineers and electrical manufacturing or supply houses throughout the United Kingdom, the British colonies, Europe, Asia, Africa, Central and South America, and the United States. Naturally, the British and the colonial divisions are the most complete, but most of the prominent engineers of this country are included. In addition, there is a lot of local matter of interest to the electrical trades in Great Britain, and a good deal of statistical information of the British industries. There is also the usual biographical section, which contains brief sketches of men who have been prominent in electrical science or its applications. This section includes a good number of portraits. The arrangement of the present edition is a little different from that heretofore. The book is divided into two volumes—one consisting merely of the directory, the other containing all the other sections.

PERSONAL MENTION.

MR. C. E. ANTHONY has resigned as manager of the Palo Alto, Cal., office of the Sunset Telephone Company.

MR. C. A. COOK, manager of the Hannibal exchange of the Missouri & Kansas Telephone Company, has been made manager of the company's St. Joseph exchange.

MR. J. F. STOCKWELL, manager of the Ontario Telephone Company, Oswego, N. Y., has been elected vice-chairman of the New York State Independent Telephone Company.

MR. CHARLES R. HUNTLEY, general manager of the Buffalo, N. Y., General Electric Company and the Cataract Power and Conduit Company, has just returned to his home from a trip of about a month through the far West and Southwest.

MR. EDMOND ROBB has succeeded Mr. Owen M. Burgess as manager of the Nashville, Ill., and Okawville, Ill., exchanges of the Central Union Telephone Company. The latter has gone to Kansas City, Mo., where he will be assistant superintendent of the Missouri-Kansas line.

MR. GEORGE S. REINOHL has resigned as manager of the Pennsylvania Telephone Company, Scranton, Pa., his resignation to take effect April 1. From Scranton Mr. Reinohl will go to Reading, where he will open an office and act as the representative of J. B. Russell & Company, brokers.

MR. H. W. MOSHER, district manager at Iron Mountain, Mich., for the Michigan State Telephone Company, has been transferred to southern Michigan as district manager, with headquarters at Battle Creek. Mr. Mosher will be succeeded at Iron Mountain by Mr. A. A. Sheperd, of St. Ignance.

MR. M. K. EYRE, formerly of the Buckeye Electric Company, of Cleveland, Ohio, has recently become associated with the Sawyer-Man Electric Company, and will make his headquarters in New York city. Mr. Eyre is an experienced incandescent lamp manufacturer, a graduate of Annapolis, and possesses a wide acquaintance in the electrical field.

MR. WALTER H. WHITESIDE has been appointed vice-president of the Allis-Chalmers Company, Milwaukee, Wis., to take the place of Mr. William J. Chalmers, resigned. For some time Mr. Whiteside has been general manager of sales for all the departments of the Allis-Chalmers Company. He entered upon this duty about the middle of July last.

MR. J. SIEGEL was elected treasurer and director to succeed Mr. F. Siegel at the annual meeting of the Strowger Automatic Telephone Exchange Company, Chicago, Ill. Mr. C. C. Wheeler succeeds Mr. A. G. Wheeler, Jr., as vice-president and director. Mr. S. F. Harris was elected assistant treasurer, a new office. The company reported that it was free from debts and had a surplus on hand.

MR. E. H. WESTERFIELD, manager of the Tampa, Fla., office of the Western Union Telegraph Company, has resigned his position to become identified with the American Sand, Brick and Lime Company, of Chicago, Ill. He will be succeeded temporarily in Tampa by Mr. W. G. Peebles, assistant superintendent of the Florida division of the Western Union Telegraph Company.

MR. J. H. HALLBERG, the well-known consulting engineer, has been retained on the commission on municipal electric lighting in New York city, in an advisory capacity. Mr. Hallberg has had a great deal of experience in matters of this nature. His work as superintendent of the Cincinnati Gas and Electric Company was especially successful, and since resigning this position and engaging again in consulting engineering last May he has devoted much time to central station problems.

MR. GARDINER C. SIMS, the well-known steam engineer and inventor, has become general manager of the Marine Engine and Machine Company, of New York. The works of this company are at Harrison, N. J. In addition to its present business the company is going to build Armington & Sims engines, and announces that the original characteristics of the engine are still its fundamental features, but have been improved in detail as required by modern steam practice. The present patterns are all new, having been developed by Mr. Sims since the Spanish-American war, in which he served with high honors in the marine service.

ELECTRICAL SECURITIES.

The favorable conditions in the stock market still continue to indicate a decided tendency to cheerfulness and confidence in the business outlook. All influences seem to be exerted to maintaining high securities values, and although advances have been irregular during the past week the closing quotations show in many cases new high levels for the year so far. Notwithstanding the large number of transactions, the report is current that the public as an investor has been conspicuous in its absence. There is no extreme anxiety to buy anything and everything that shows an inclination to rise in value over night, but rather a quiet investment in securities of undoubted stability, depending on future growth rather than present-day speculative possibilities. From many sections of the country come reports of improving trade. It is not unlikely that the steel stocks will again become leaders in industrial securities, and if the reports for the present quarter come up to what is being said for the demand, it is possible that they will be active within a very short time. The increase in output and demand for these materials means in nearly all cases new construction or rehabilitation of existing properties. This in turn means more work in almost every class of industry. From present indications the spring will see a large amount of work being undertaken, and it is not too much to say that the money circulated through this form of enterprise will find its way into every channel which goes to make up the national prosperity.

ELECTRICAL SECURITIES FOR THE WEEK ENDING MARCH 11.

New York:	*Closing.*
Brooklyn Rapid Transit	66⅝
Consolidated Gas	213
General Electric	188
Interborough Rapid Transit	219
Kings County Electric	200
Manhattan Elevated	171
Metropolitan Street Railway	123¼
New York & New Jersey Telephone	172
Westinghouse Manufacturing Company	190

The annual meeting of the Commercial Cable Company has been postponed until April 3.

Manhattan quarterly dividend of 1¾ per cent is payable April 1. Books close March 17 and reopen March 30.

The Metropolitan Street Railway Company will pay the regular guaranteed rental of 1¾ per cent on April 16. Books close March 24 and reopen April 16.

The gross earnings of the Brooklyn Rapid Transit Company for February show a gain of $85,000, as compared with the same month of 1904.

The Western Union Telegraph Company has declared a quarterly dividend of 1¾ per cent upon the capital stock, payable April 15 to stock of record at the closing of the books on March 20. The quarterly report of the company shows a net revenue for the quarter ending December 31, 1904, of $1,872,966, leaving a balance, exclusive of bond interest, of $1,575,416; dividends, $1,217,021, and a surplus of $358,395. This, added to the previous surplus of $15,434,863, makes a total surplus of $15,793,258.

Boston:	*Closing.*
American Telephone and Telegraph	146¼
Edison Electric Illuminating	251
Massachusetts Electric	65
New England Telephone	137
Western Telephone and Telegraph preferred	102

Philadelphia:	*Closing.*
Electric Company of America	12⅛
Electric Storage Battery common	87½
Electric Storage Battery preferred	87½
Philadelphia Electric	10¾
Philadelphia Rapid Transit	30
United Gas Improvement	116½

United Gas Improvement directors have declared the regular quarterly dividend of 2 per cent ($1 per share), payable April 15 to stockholders of record March 31.

Chicago:	*Closing.*
Chicago Telephone	142
Chicago Edison Light	170
Metropolitan Elevated preferred	65
National Carbon common	42
National Carbon preferred	113
Union Traction common	12
Union Traction preferred	47

ELECTRIC LIGHTING.

PETROS, TENN.—The town of Petros will be lighted from the plant of the Big Brushy Mountain Coal and Coke Company.

JEFFERSONVILLE, IND.—James H. Duffy is proposing to establish an incandescent electric light service in Jeffersonville.

BELLEFONTAINE, OHIO—Bellefontaine expects to rebuild this summer its entire municipal plant with a bond issue of $50,000.

ALMA, NEB.—At a special election for waterworks and electric lights, 175 votes were east for waterworks to 25 against, and 186 for electric lights to 15 against.

VICTORIA, B. C.—The electric light committee has recommended the purchase of a new dynamo of 230-light capacity, additional arc lamps, transformers, etc.

URBANA, OHIO—A new company headed by C. H. Marvin and T. A. Edmondson now holds a franchise for an electric lighting and hot-water heating plant in Urbana.

BROWNSVILLE, PA.—The Brownsville Light, Heat and Power Company proposes installing a 250-horse-power engine and a 200-kilowatt generator. J. M. Bell is manager.

RHINEBECK, N. Y.—The Duchess Light, Heat and Power Company in order to provide for its growing business has purchased a 200-horse-power water-tube boiler.

CADOTT, WIS.—The village of Boyd has granted a franchise to the Cadott Light and Power Company. The company will extend its line to that village in the near future.

SCRANTON, PA.—W. T. Davies, John H. Williams, Herbert L. Taylor, Thomas P. Gordon and Edward Recum will incorporate the West Scranton Light, Heat and Power Company.

NEWARK, OHIO—Bids will be received by the board of public service, T. P. Kellogg, clerk, March 21, for furnishing for a period of ten years a system of electric lamps or of gas lamps, or a combination of them.

WILKESBARRE, PA.—The Wyoming Valley Gas and Electric Company has secured control of the Hazleton Gas Light Company, which is capitalized at $125,000. The purchasing company was recently formed by Chicago capitalists.

TURTLE CREEK, PA.—The Rose Hill Electric Light Company has purchased a site for a plant in Newtown, where a large power-house will be erected. Bids are being taken for the construction of the buildings, which will be of iron and brick.

WHEELING, W. VA.—The Dillonvale Heat, Light, Power and Water Company has been organized, and has already purchased a site for the plant, which will be located on Piney creek. The work of setting poles and stringing wires has been begun.

TERRE HAUTE, IND.—J. F. McColloch, of the firm of McColloch & Company, of St. Louis, has been employed by the board of public works in procuring data and drawing up plans and specifications for the erection of a municipal lighting plant in Terre Haute.

SELINS GROVE, PA.—George W. Wagenseller and David Goldstein have secured the franchise for lighting by electricity all the principal towns in Snyder County. The generating power will be furnished by Hoover's dam, three miles south of Selins Grove.

NIAGARA FALLS, N. Y.—At a meeting of the council a franchise was granted to the Niagara Falls Hydraulic Power and Manufacturing Company to build conduits in the city streets and lay cables for the distribution of electricity for heat, light and power purposes.

NILES, OHIO—The city light and waterworks contemplates changing its street lighting from direct current open to alternating current enclosed; also the installation of either a 300-kilowatt turbine or direct-connected engine and generator, and a new feed-water heater

MEMPHIS, TENN.—A franchise for a period of thirty years has been granted to the Merchants' Light and Power Company by the Memphis legislative council. In exchange for the franchise, the new company gives to the city of Memphis fifty arc lights, to be erected along Main street.

NEW YORK, N. Y.—Plans for the city electric light plant for the Williamsburg bridge have been filed. It will be the city's first venture into municipal ownership of light plants. The plant will be built in Tompkins street, south of Delancey slip, adjoining the new incinerating plant, and will cost $20,000.

WICKFORD, R. I.—The Wickford Light and Water Company which recently purchased the electric light plant in Wickford, owned by H. S. Dixon, is having transformers and other apparatus placed in position. The plant will be connected with the power-house of the Sea View Railway Company, which will in future furnish the electric lights of Wickford.

GEORGETOWN, DEL.—The Georgetown council has granted to the Georgetown Electric Light Company a franchise and a contract to light the city. There will be 100 lights installed. The company consists of George W. Goodley, W. R. Goodley and W. J. Peal, of Wilmington. The company has already awarded the contracts and the work of installing the plant will begin at once.

COLORADO SPRINGS, COL.—The following officers were elected at the meeting of the directors of the Colorado Springs Electric Company: W. A. Otis, president; George R. Buckman, first vice-president; S. R. Bertron, second vice-president; Irving W. Bonbright, secretary and treasurer; F. H. Stehr, assistant secretary and treasurer; George B. Tripp, general manager.

MACON, MO.—By a detailed report submitted by the electric light and waterworks committee of the council it is shown that the municipal plants earned last year $867.76, the first time in the fifteen years' existence of the utilities named that the balance has been on the right side of the ledger. The installation of meters and more systematic methods are said to have accomplished the reform and placed the city properties on a paying basis.

EASTON, PA.—The plant of the Lehigh-Northampton Gas and Electric Company at Catasauqua will be overhauled, modernized and enlarged. The improvements will require several months' time. William W. McKee, the receiver, is arranging for the work. Two new engines of 200 and 400-horse-power capacity, a new Stirling boiler, improved condenser, water heater, pumps and switchboard will be installed, and a third wire run through the boroughs of Alliance and Coplay, to afford better service.

DETROIT, MICH.—The Indiana & Michigan Electric Company reports for the year ended December 31, 1904, gross earnings $214,339; operating expenses and taxes $109,405; net earnings $104,934; interest charges $37,500; surplus $67,434. It is reported that $550,000 of the company's first lien five per cent gold bonds have been sold. There are $1,500,000 of these bonds authorized, but the company reserves in its treasury $750,000. The bonds are subject to call at 105 and interest. The net earnings of the company are about three times the amount required for interest on the bonds.

DULUTH, MINN.—The Great Northern Power Company has awarded the contract for the construction of its canal to Porter Brothers, of Duluth. The work has been started, and will be completed within a year, the limit set being March 1, 1906. Three large steam shovels will be in continuous operation. The canal will be two miles long. Where it goes through rock it will be thirty feet wide at both the bottom and the top, with perpendicular sides, but where earth is to be excavated the canal will be thirty-six feet wide at the bottom and the sides will extend outward, with the width at the top ninety-six feet.

CANTON, GA.—A. J. Warner, formerly of Ohio, but now of Gainesville, and his associates, have been granted a charter by the Cherokee superior court incorporating the Etowah Power Company, with a capital of $10,000, with the privilege to increase to $1,000,000. The company expects to build a dam 600 feet long and thirty feet high across the Etowah river, about four miles below Canton, which probably will be completed during the year. The company organized by the election of A. J. Warner, president; E. P. Kirby, vice-president; W. H. Slack, secretary and treasurer; P. P. DuPre, of Canton, general counsel; W. A. Carlisle, chief engineer, and F. P. Catchings, electrical engineer. Board of directors: A. J. Warner, W. A. Carlisle, W. F. Huntley, E. P. Kirby, all of Gainesville; C. M. Merrick, of Pennsylvania, and P. P. DuPre and F. P. Burtz, both of Canton. The company has already acquired some property along the Etowah river.

TELEPHONE AND TELEGRAPH.

TRESCOTT, KAN.—The Trescott Telephone Company will install an exchange at Culver.

MARBLE FALLS, TEX.—The Texas Telephone Company has purchased the Martin lines for $27,500.

WALLA WALLA, WASH.—A rural telephone line has been built by the Hudson Bay Telephone Company.

FORT WAYNE, IND.—At a meeting of the board of the town trustees of Roanoke the Farmers' Mutual Telephone Company was voted a fifty-year franchise.

DOYLESTON, PA.—The Mutual Telephone Company held its annual meeting at Eureka on February 20. The treasury showed that the company was in a flourishing condition. The old officers were reelected.

ELMONT, N. J.—The New York & New Jersey Telephone Company has secured permission from the property holders along the Elmont road to run a telephone connection from the Hempstead road to the Merrick road.

AUBURN, N. Y.—The Empire State Telephone and Telegraph Company has elected the following directors: Charles I. Avery, U. N. Bethell, C. F. Cutler, F. P. Fish, F. G. Fincke, Thomas Sherwin, H. L. Storke, George Underwood, F. G. Wood.

SARATOGA SPRINGS, N. Y.—The Granville Telephone Company has purchased the Comstock-North Granville private telephone line, which was practically owned by C. K. and I. V. Baker, and the line will probably be extended to Fort Ann village in the spring.

CLINTON, N. J.—It is reported that the Farmers and Merchants' Telephone Company is about to extend its line from Cokesbury to Califon and German Valley, and that the Lebanon Telephone Company will also extend its line from Califon to Vernoy, Teetertown, etc.

BUTLER, PA.—Butler, Kittanning and Pittsburg parties have organized the Butler & Coylesville Telephone Company, and will construct a line from Butler to Kittanning by way of Coylesville. The new line will be connected with the Pittsburg and Allegheny Telephone Company's line.

DECATUR, ALA.—The Long-Distance Telephone and Telegraph Company, with a capital of $500,000, has been incorporated to build and operate a system of long-distance telephones in Alabama and other states. The main leader in this enterprise is E. L. Barber, of Wauseon, Ohio. Associated with him is J. C. Monteith.

UNION, S. C.—The Bell telephone and exchange, at Union, which began business March 1, 1902, with fifty-six subscribers, and which by the absorption and consolidation of the independent exchange on January 1, 1903, secured fifty-two additional subscribers, is about to make extensive improvement, which will give the exchange a capacity of 500 stations.

RICHMOND, VA.—A telephone company has been organized with Cleve Harding, president, and E. L. Sterne, secretary and treasurer, to build a line from Tackett's Mill, in Stafford, to White Ridge, in Fauquier County, where it will connect with the Cedar Run Company's line. It is expected that the line will be in operation in sixty days.

ELLSWORTH, ME.—The Union River Telephone Company has been organized at Amherst for the purpose of operating telephone lines in the towns of Amherst, Aurora, Mariaville, Otis, Eastbrook, Waltham, Clifton and the city of Ellsworth with a capital stock of $8,000. Albert E. Mace, of Aurora, is president, and Herbert T. Silsby, of Aurora, treasurer.

FIRTH, NEB.—Firth has organized a telephone company to be known as the Firth Telephone Company. The following officers were elected: J. M. Van Burg, president; C. Wismer, vice-president; M. H. Wittstruck, secretary; John Remmers, treasurer. The plans are to have the stockholders and patrons buy and own the telephones and lines outright.

ROCHESTER, N. Y.—It is understood that a company is about to be organized, to be known as the Inter-Laken Telephone Company. The company will be connected with the Inter-Ocean Telephone Company, at Auburn, thus giving long-distance service. It is expected to furnish telephone service to King's Ferry, Aurora, Scipio Center, Fleming and all intermediate points.

KILLAWOG, N. Y.—The Rural Telephone Company, of Killawog, has sold its interest in the line to the Killawog Telephone Company, and at a recent meeting nine directors were elected as follows: R. J. Tarbell, T. R. Hitt, Marvin Muckey, Killawog; Carley Adams, A. C. Baker, C. A. Brooks, Marathon; A. Dickinson and Messrs. Shevaliers and Messengerville. The line is to run through Messengerville, and west to meet the Dryden line.

CHEMAWA, ORE.—Poles have been set and wires strung for the Chemawa farmers' telephone line. A stock company has been formed and incorporated, and the members of the association have done the construction work among themselves. An agreement has been entered into with the Pacific States Telephone Company on terms that will assure the subscribers of the system very reasonable rates. They now have about thirty telephones on the system, which taps one of the best suburban districts.

SAN DIEGO, CAL.—The Southwestern Home Telephone Company has been at work for the last three months establishing lines in the towns of Banning and Beaumont. From Banning a toll line is under way to San Jacinto *via* Relief Hot Springs. As soon as this is completed the company will begin running the lines on to Indio, and from there to Mecca. The company will then push eastward to Yuma *via* the Imperial valley. At Yuma the company connects with the independent toll lines from Prescott and Phoenix.

ALBANY, N. Y.—At a meeting of the stockholders of the Hudson River Telephone Company, the annual report submitted by the directors showed an increase in income for the twelve months of $18,890, an increase in interest charges of $27,435, and a decrease in funds remaining for dividends of $8,545. The net revenue applicable to dividends was $244,416, and the dividends paid amounted to $234,372. Additions and betterments during the year placed in the construction account aggregated $527,915. The gain in the number of telephones was 5,176.

WILLIAMSPORT, PA.—The North Mountain Telephone Company has been organized, and will run a new line from Muncy Valley *via* North Mountain post office and Lungerville to Unityville. Work will be started immediately, and it is expected the line will be in operation by July 1. The following officers have been elected: president, Burgess Swisher, of North Mountain; vice-president, James Lunger, of Lungerville; secretary, Jefferson Secules, of Muncy Valley; treasurer, Albert Myers, of Muncy Valley; directors, Thomas Schug, George Chestnut and Abraham Bigger.

PITTSBURG, PA.—The Pittsburg & Allegheny Telephone Company is completing the installation of one of the largest private branch exchange systems ever ordered from any telephone company. The Carnegie Company has adopted the Pittsburg & Allegheny system exclusively for its private exchange system, and now has in operation nine exchanges with almost a thousand telephones There are about one hundred telephones in the Carnegie Building, Fifth avenue, with trunk lines and branch exchanges at Homestead, Duquesne, Braddock, the Edgar Thomson works, South Sharon, Youngstown, etc.

MINNEAPOLIS, MINN.—H. J. Pettengill, Boston, Mass., who succeeded C. E. Yost as president of the Northwestern Telephone Company, has assumed charge, with headquarters in Minneapolis. Mr. Pettengill is planning many changes and improvements. One of the most important improvements will be the erection of a large toll office on the east side, which will be made the central toll office of the company. The American Telephone and Telegraph Company has been requested to have its wires in the East Minneapolis office. Much underground laying of wires is also planned for this year. Mr. Pettengill proposes stringing 1,000 miles of toll circuits. The company now has 30,000 miles of copper wire strung, which accommodates over 30,000 subscribers.

UTICA, N. Y.—The annual meeting of the stockholders of the Central New York Telephone and Telegraph Company was held at the offices of the company recently. Only routine business was transacted. The president made his annual report to the stockholders. The following directors were elected for the ensuing year: U. N. Bethell, New York; G. L. Bradford, Utica; C. F. Cutler, New York; F. P. Fish, Boston; L. H. Lawrence, Utica; J. F. Maynard, Utica; F. T. Proctor, Utica; C. B. Rogers, Utica; Joseph Rudd, Utica; Thomas Sherwin, Boston; F. G. Wood, Utica. At the meeting of the board of directors the following were elected: chairman of the board, C. F. Cutler, New York; U. N. Bethell, New York, president; Joseph Rudd, Utica, vice-president; F. G. Wood, Utica, secretary and treasurer.

ELECTRIC RAILWAYS.

JERSEY SHORE, PA.—The Jersey Shore Street Railway Company will install a 225-kilowatt railway outfit.

UNION, S. C.—A plan to connect Union, Spartanburg and Gaffney with the summer resorts of North Carolina by an electric line is on foot.

SYRACUSE, N. Y.—An extension of the Syracuse, Lakeside & Baldwinsville road to Phoenix, and possibly to Fulton, is contemplated. About $400,000 will be expended.

MANSFIELD, OHIO—Surveyors for the Citizens' Electric Railway Company are reported to be laying out a line to connect with the Cleveland & Southwestern Traction Company.

COLUMBUS, OHIO—The Columbus Railway and Light Company will make a number of improvements this year, among them being the installation of a large storage battery station.

ELIZABETHTOWN, PA.—Ordinances have been passed by the Elizabethtown council granting franchises to the Philadelphia, Lancaster & Harrisburg Electric Railway Company.

CINCINNATI, OHIO—The Cincinnati Rapid Transit Railroad Company, J. G. Schmidlap, president, plans to build an elevated railroad in Cincinnati, operated by the third-rail system.

SCRANTON, PA.—W. L. Connell is said to be at the head of a company which proposes to construct an electric railway through Chinchilla, Glenburn and Dalton, from Providence Square.

OTTAWA, QUEBEC—The Ottawa River Railroad Company has awarded a contract to M. P. McGrath, of Easton, Pa., for the construction of an electric line between Montreal and Ottawa.

SHENANGO, PA.—The Shenango Street Railway Company will ask for bids for its road, sixty-four miles long, as soon as rights of way are secured. W. H. Waugh, Greenville, Pa., is chief engineer.

WOOSTER, OHIO—C. V. Hard, of Wooster, is reported interested in the construction of the Cleveland, Ashtabula & Mansfield Railway, which will connect with the Cleveland & Southwestern at Wellington or Medina.

LIMA, OHIO—The last franchise for the construction of the Toledo, Ottawa and Lima electric railway has been secured and work is assured for the early spring. J. B. Mayer, president, Lima Electric Railway and Light Company, is interested in the project.

PHILADELPHIA, PA.—Work on the construction of the Washington, Baltimore & Annapolis electric line will be started within a few weeks. The Bishop-Sherwin syndicate will soon take charge of the property, and the Roberts & Abbott Company will do the construction work.

ADRIAN, MICH.—The Adrian & Jackson electric road is to be built. J. W. Helme and W. H. Hand, of Adrian, have been working on the proposition for a year, and have now practically secured all the franchises except in Adrian, where the route has not yet been decided upon.

BALLSTON, N. Y.—The Eastern New York Railroad Company has given to the Metropolitan Trust Company a mortgage of $1,750,000 to cover that amount of five per cent bonds. The railroad company will build electric lines from Ballston to Gloversville, Amsterdam and Johnstown.

SAN MARCOS, TEX.—The company which purposes to construct the electric line from San Marcos to Luling has been organized. San Marcos capitalists are interested. A. L. Davis, of San Marcos, is president, and A. K. Lipscomb, of Luling, is vice-president. The surveying party has begun work.

FREEPORT, ILL.—The city council of Freeport at a special meeting granted a franchise to the Freeport-Dixon Electric Railway Company to operate its line in that city. The ordinance provides that the company is to enter the city on its own tracks and that it must provide a city service on the south side.

SIOUX CITY, IOWA—Improvements costing between $125,000 and $150,000 will be made by the Sioux City Traction Company as soon as material arrives from the East, and the company is assured of continued good weather. Rails for six miles of new track have been ordered. The plans announced call for double, standard gauge tracks on nearly every line in the city.

NEW LEXINGTON, OHIO—It is reported that Edward S. Martin, of New Straitsville, has completed arrangements for the financing of the Perry Electric Railway, Light and Power Company, which proposes to build an electric railway from New Straitsville to Zanesville by way of New Lexington. Work is to be started soon.

LAKE CHARLES, LA.—The contracts have been let for the supplies necessary to change the present horse car street railway to an electric line. President Bird, of the Lake Charles Street Car Railway Company, says that about five miles of track will be laid; that construction will be begun immediately, and that the line will probably be in running order by June 1.

WATERBURY, CT.—The New England Engineering Company has secured the contract for the electrical work for a trolley line from Jeanette to West Newton, Pa., which is to be built by the Jeanette, West Newton & Monongahela Valley Street Railway Company. The road will be about thirteen miles long, and it will pass through the towns of Edna, Arona and New Madison. The construction work will begin about April 1. Approximately $325,000 is involved in the contract.

ST. THOMAS, ONT.—The Southwestern Traction Company and the city council have come to an agreement, the city accepting the Traction Company's offer for the use of the St. Thomas's street railway lines through the city. The company has received a fifty-year franchise and makes an agreement for twenty-five years to pay the city $1,200 per year per mile for the first five years, $1,350 for the second, $1,500 for the third, $1,550 for the fourth, and $1,750 for the last five years.

BIRMINGHAM, ALA.—At the annual meeting of the stockholders of the Birmingham Railway, Light and Power Company it was agreed to stand by the action of the stockholders in proposing to expend $700,000 this year for improvements on the local light and street railway plants, and it was further decided to reduce the cost of electric lights to the public. The year 1904 was the best the company has had. It paid $590,000 in interest and dividends. All the old officers were reelected.

WAPSKONETA, OHIO—F. D. Carpenter, general manager of the Western Ohio Railway Company, states that bids have been received for the construction of the Lima, Findlay & Fort Wayne electric line, a distance of thirty-two miles, between Lima and Findlay. The Lima, Findlay & Fort Wayne company has also decided to issue $300,000 in first preferred cumulative stock at par. When this line is completed the western part of Ohio will have an unbroken trolley route between Toledo and Cincinnati.

LAWTON, OKLA.—It is announced by the Lawton, Wichita Mountain & Western Electric Railway Company that it expects to begin the construction of a line from Lawton to the Wichita mountains, by way of Fort Sill, as soon as the game preserve has been established and Fort Sill has been made a regimental post, both of which have been recently provided for by Congress. The company has a franchise in Lawton, and a certified check for $1,000 has been presented as a guarantee that it will build the line. It will be about twenty-five miles in length, and will probably be extended northwest to Hobart.

DES MOINES, IOWA—Engineers have commenced work on the proposed Porter electric road, from Des Moines, through Nevada, to Eldora. It is intended to build the Des Moines and Nevada section this season. This is the line that is to be built in conjunction with the Polk lines out of Des Moines, the Polks to supply an entrance to Des Moines from near Saylor and the Porter interests to build the balance of the line. The survey has been started from the end of the old Polk survey about midway between the old town of Saylor and the town of Ankeny, where it is proposed this new road will cross the Northwestern.

YORK, PA.—The lower end of York County is to have better transportation facilities. A bridge will be built over the Susquehanna, at York Furnace, this spring, it is said, by a number of capitalists, chief of whom are the owners of the Lancaster & Pequea Trolley Company, and the Pequea, Chestnut Level and New Oxford trolley companies, of Lancaster County. The presumption is that the lines will be immediately extended into the Chanceford townships in York County, and on to Delta and Red Lion to con-

nect with the existing lines of the York County Traction Company. The surveys already have been made, and a charter for the bridge will be applied for.

EDUCATIONAL.

LECTURES FOR THE ENGINEERING STUDENTS OF THE UNIVERSITY OF MINNESOTA—On February 24, Mr. Fred G. Dustin, city electrical inspector for Minneapolis, Minn., gave a lecture before the Society of Engineers of the University of Minnesota, on "Safety in Electrical Installation." After describing the development of the present insurance rules Mr. Dustin took up the city ordinance governing electrical installation and operation. He showed interesting samples of defective fittings and construction which had been condemned. Samples of new devices were shown, giving examples of how the new rules were being met. He admonished the young engineers to supplement their theoretical work with practical experience, emphasizing that their ultimate success or failure would depend upon their ability to put into practical use the technical training and knowledge being acquired. On March 10 Mr. W. I. Ely, of the Murphy Iron Works, Detroit, Mich., addressed the society on "Smoke Prevention." On March 17 Mr. C. E. Downton, of the Westinghouse Electric and Manufacturing Company, gave an illustrated lecture on the company's Pittsburg factory and products. On March 24 Mr. Benjamin Waller, resident engineer of the Northwestern Telephone Exchange Company, will lecture upon "Some Novel Features of a Modern Telephone Exchange."

OBITUARY NOTICES.

PAOLI CASTELLI, the inventor of the Castelli coherer, with which Signor Marconi first succeeded in receiving signals across the Atlantic, died recently at his home in Italy. Castelli was corporal in the signal corps of the Italian navy, and was assigned to assist the officers who were making tests with wireless telegraphy. While engaged in this work he invented the coherer which bears his name.

MR. SEABURY BREWSTER WILEY died in Birmingham, Ala., on Saturday, March 11. He was a son of Charles Wiley, vice-president and treasurer of the firm of John Wiley & Sons, scientific publishers, New York city. He was about forty years old. For many years he was connected with the Blauvelt-Wiley Paper Company, of New York, being one of the incorporators and a joint owner. Subsequently he sold out his interest in that concern and became identified with the Toledo Pipe Threading Company, of Toledo, Ohio. The body was brought to East Orange, the residence of his father, for burial.

MR. D. H. CONKLIN, former mayor of Decatur, Ill., and a prominent railroad manager, died at his home in that city, Friday, March 11, at the age of seventy-four years. He was a printer's apprentice in Peekskill in 1848, and later came to New York, where he was employed on the *Tribune*. He was one of the first to learn telegraphing on the old Ezra Cornell line, which was installed by Cornell on the New York & Erie Railroad from Piermont to Goshen. In the winter of 1851 Superintendent Mino, of the Erie, induced Mr. Conklin to leave the printing office to take charge of the telegraph office at Piermont, with a salary of thirty dollars a month, and he thus became the first telegraph operator to receive a salary from a railroad company. He assisted in stringing the first insulated wires under drawbridges on the Paterson & Ramapo and Paterson & Hudson River railroads, and opened several telegraph offices on the Susquehanna & Western divisions of the Erie. In 1866 he became Erie train despatcher at Port Jervis. Early in the seventies he went to Illinois and became president and general manager of the Illinois Central Railroad Company, with headquarters at Decatur. He retired from active railroad service several years ago with a competency, and in 1894 was elected mayor of Decatur. His body was brought to Port Jervis on Monday for interment.

NEW COMPANIES.

TOLEDO, OHIO—The Yost Electric Manufacturing Company has been formed by F. H. Chapman and others. The capital is $200,000.

SPRINGFIELD, ILL.—The American Carbon Battery Company, of St. Louis, Mo., has been incorporated under the laws of Illinois with a capital of $75,000.

CHICAGO, ILL.—The Clark Electric Meter Company has been incorporated with a capital of $2,500, by Eugene J. Clark, Frank W. Robett and Max A. Gorman.

LITTLE ROCK, ARK.—The Treadway Gilman Electric Company has been organized to engage in electrical construction and to do a consulting engineering business.

BOSTON, MASS.—The Monitor Electrical Speed Recorder Company has been formed by James H. Kendall, Newton; Andrew W. Jones, Cambridge, and Edgar B. Champlin, of Boston. The capital is $5,000.

PORTLAND, ME.—The Electro-Radiation Company has been organized with a capital of $100,000, to manufacture electrical apparatus. The officers are: president, H. W. Libby; treasurer, A. H. Burwell.

TRENTON, N. J.—The Porcelain Electrical Manufacturing Company has been organized by Charles A. Secor, New York city; William I. Peacock and Frederic R. Brace, Jr., of Trenton, N. J. The capital is $25,000.

BOSTON, MASS.—A new corporation, known as the Telelectric Company, has been organized in Pittsfield, Mass., to manufacture an automatic electric piano player. The company is capitalized at $400,000. John F. Kelley is at its head.

CINCINNATI, OHIO—The Electrical Appliance Company has been incorporated at Columbus with $10,000 capital, by Kenna Dunham, William C. Pierce, Stanley Matthews, Edna Kennedy and T. Paschen. The company will manufacture a patented device for the transformation of an alternating into a direct current.

NEW YORK, N. Y.—The Beesley, Benn & Lehman Manufacturing Company, of New York, has been incorporated to manufacture mechanical and electrical appliances. The company has a capital of $40,000, and the directors are James Beesley, of Brooklyn; Louis Frederick Benn, of Bayonne, N. J., and Joseph A. Lehman, of Roselle, N. J.

INDUSTRIAL ITEMS.

WILLIAM ROCHE, 52-54 Park place, New York city, manufacturer of dry batteries, coils, etc., has distributed a large calendar. The calendar gives views of a number of points of interest around New York.

PATTERSON, GOTTFRIED & HUNTEE, LIMITED, 146-150 Center street, New York city, have issued catalogue No. 39, describing blacksmiths' tools. The catalogue contains 252 pages and is well illustrated.

THE MONARCH ELECTRIC MANUFACTURING COMPANY, Warren, Ohio, maker of incandescent lamps, has appointed the H. L. Whaley Company, 22 East Twenty-first street, New York, its eastern agent.

THE TRAY PLATE BATTERY COMPANY, Binghamton, N. Y., is calling attention to the storage battery manufactured by it. The company is distributing copies of testimonials received by it as to the worth of the battery.

THE ELECTRO-DYNAMIC COMPANY, Bayonne, N. J., is distributing a number of bulletins descriptive of its "Inter-Pole" variable-speed motor. The company will be pleased to send these bulletins upon request to any one interested.

THE UNION SWITCH AND SIGNAL COMPANY, Swissvale, Pa., is sending out bulletin No. 23, describing the electric train staff system, and also errata slips for the first edition of section 3, describing mechanical locking and operating devices.

THE STIRLING COMPANY, Chicago, Ill., will remove its general offices to the new Trinity Building, New York city, next month. This company is a well-known manufacturer of water-tube safety boilers, and has branch offices in all the leading cities, with extensive shops and foundry at Barberton, Ohio. Mr. E. R. Stettinius, the treasurer and active manager of the company, will make his headquarters in New York city in the future.

THE SUMTER TELEPHONE COMPANY, Sumter, S. C., has issued a large wall calendar. A photograph of the company's fac-

tory and illustrations of the various type of telephones manufactured by this company are shown on the upper part.

THE ELECTRIC APPLIANCE COMPANY, 92-94 West Van Buren street, Chicago, Ill., is announcing a useful life for the Packard lamp of from 600 to 800 hours. If, at the end of that time, the lamp has not become unfit for service, the company advocates its removal from the circuit.

THE UNITED ELECTRICAL MANUFACTURING COMPANY, 43 Murray street, New York city, has issued a neat catalogue descriptive of "Crescent" dry batteries. This catalogue describes the various forms of "Crescent" dry cell, and, in addition, apparatus for automobile or launch engine ignition.

THE BOROUGH BRONZE COMPANY, New York city, announces the opening of its chandelier showrooms at 130-132 West Twenty-fourth street. This company has gone to great expense and trouble in making its showrooms the finest that can be found in the city. The company held a reception on Wednesday, March 8.

PASS & SEYMOUR, INCORPORATED, Solvay, N. Y., are calling attention to P. & S. porcelain pendant sockets. These are made both in key and keyless forms, in Edison and Thomson-Houston bases. Special prices are being quoted to the electrical trade. The literature will be sent to any one interested upon request.

THE DE LAVAL STEAM TURBINE COMPANY, Trenton, N. J., has issued a catalogue describing the centrifugal pumps manufactured by it. In addition to the description of the pumps a description of the test made on the pump last year by Professors Kent and Denton, together with the report made by these gentlemen, is given.

THE W. F. DOLL MANUFACTURING COMPANY, 175 Broadway, New York, has put on the market what is termed the "Doll" non-magnetic watch. It has been made specially to meet the wants of electrical engineers in charge of electrical machinery. It is stated that the works are thoroughly non-magnetic, and are of the latest design, superfinished, and are enclosed in strong American gun metal cases.

THE WILLIAMS GAUGE COMPANY, 543-547. Fourth avenue, Pittsburg, Pa., is distributing a catalogue calling attention to the steam specialties manufactured by it. These include feed-water regulators, steam traps, pump governors, water columns, gauge cocks, etc. It is also sending out a pamphlet containing reproductions of some of a large number of orders which it has received for these specialties.

THE H. W. JOHNS-MANVILLE COMPANY, 100 William street, New York city, will be pleased to furnish on application full information concerning "Asbestocel" sectional pipe covering. This consists of several layers of corrugated asbestos paper, placed so that the corrugations run concentrically around the pipe. Each channel forms a closed loop, in which the air is imprisoned and eliminates longitudinal circulation.

THE AMERICAN ELECTRIC TELEPHONE COMPANY, 36-58 West Jackson Boulevard, Chicago, Ill., announces that the Independent Telephone Company, of Topeka, Kan., recently ordered an additional equipment of private branch exchange switchboards. The Topeka company has secured a contract for equipping nearly all of the hotels with this class of service. The American Electric Telephone Company has furnished all of the apparatus needed for the hotel equipments, including switchboards and telephones.

THE SPRAGUE ELECTRIC COMPANY, 527-531 West Thirty-fourth street, New York city, will be pleased to mail its bulletin No. 309, descriptive of electric fans. The bulletin shows the standard line of Sprague fan apparatus which has become so popular during the many years it has been upon the market. The Sprague company was one of the pioneers in the development of electrical fan apparatus, and has maintained this popularity, notwithstanding the excellent apparatus which is now available for selection.

THE AMERICAN ARC LAMP COMPANY, Elwood, Ind., announces that it has purchased the patents and factory of the Lea Electric Manufacturing Company, Elwood, Ind., and will continue the business, maintaining the high standard of lamps, and developing and increasing the company's operations by the addition of facilities. The factory of the Lea company will remain in active operation in Elwood, Ind., until about May 15, when it will be removed to the American Arc Lamp Company's new buildings now being erected in Kalamazoo, Mich.

THE CONSOLIDATED GAS, ELECTRIC LIGHT AND POWER COMPANY, Baltimore, Md., is distributing a booklet entitled "Powerful Aids in Manufacturing." This is one of a series of booklets which is published monthly by the company. The booklet under discussion deals particularly with notes on electric service and the availability of electric power throughout Baltimore. Illustrations are given showing the application of the electric drive to machine tools and other manufacturing appurtenances, and data are included showing the costs of power and the availability of service.

THE HOLOPHANE GLASS COMPANY, Glackner Building, New York city, is distributing a handsome pamphlet entitled "The Lighting of Large Buildings, Offices and Stores." This pamphlet is one of a series which the Holophane Glass Company has been distributing for some time. The frontispiece is a reproduction of the rotunda of the Rookery, Chicago, showing the application of Holophane glass globes. The text describes the applications of modern illumination to secure the most brilliant and attractive effect. Numerous illustrations are given, to which reference is made in the text, showing the extremely effective range of light distribution which is possessed by the Holophane products.

THE AMERICAN ELECTRICAL SUPPLY COMPANY, Chicago, Ill., has purchased the supply department of Henry Newgard & Company, and has opened up for business at 83-87 Fifth avenue, where it will carry a complete line of all kinds of electrical supplies and material. Charles Edward Brown, the president of this new company, has been associated with the electrical business for a great many years, and has for the past eight years filled the position of secretary and manager of Henry Newgard & Company. The management of the business will be under the personal supervision of Mr. F. D. Phillips who for a number of years was with the Electric Appliance Company, and for the past year as treasurer and manager of the Crescent Company.

THE ALLIS-CHALMERS COMPANY, Milwaukee, Wis., announces that the South Shore Electric Company has ordered from it one heavy duty 24 by 48 engine for direct-connection to a 425-kilowatt, alternating-current generator, to be installed in its power plant at Hammond, Ind., whose capacity is proving inadequate to take care of the heavy demands now made upon it. The People's Power Company, of Moline, Ill., has awarded the Allis-Chalmers Company the contract for one horizontal compound Reynolds-Corliss engine, 24 by 50 by 48, for direct-connection to a generator. This engine will be practically a duplicate of one previously made by the same company which has been giving excellent satisfaction. An interesting novelty in its construction is the fact that the cylinders have valves in their heads.

THE WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY, Pittsburg, Pa., is building for the People's Power Company, of Moline, Ill., two engine-type generators to be installed in its power station. The company is an old one in that section of the country, and has built up an extensive business in lighting and power work. The addition to its present equipment will be a 1,100-kilowatt, two-phase alternator of the revolving field type, operating at 2,400 and 4,800 volts, and a 600-kilowatt, 600-volt, direct-current machine. The alternating-current generator is a duplicate of a machine which the company put into service about a year ago. An order for three 300-kilowatt, alternating-current generators has also been placed with the Westinghouse company by the Barber Lumber Company, of Boise, Ida. These machines will generate current at 440 volts, which will be transformed to 23,000 volts for transmission. The necessary transformers, switchboards and lightning arresters are included in the apparatus to be furnished. The Mammoth Copper Mining Company, of Salt Lake City, has just placed an order with the Westinghouse company for a large addition to its electrical equipment. A total of nearly 800 horse-power in induction motors of different sizes, together with a motor-generator set, transformers, switchboard and three mining locomotives, is included in the order. The motors, two of which have a rated capacity of 200 horse-power each and five of fifty horse-power each, will operate on three-phase, 2,000-volt circuits.